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U. S. DEPARTMENT OF AGRICULTURE  
BUREAU OF BIOLOGICAL SURVEY  
HENRY W. HENSHAW, *Chief*

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# NORTH AMERICAN FAUNA

## No. 38

[Actual date of publication, September 30, 1915]



### A REVIEW OF THE AMERICAN MOLES

BY

HARTLEY H. T. JACKSON  
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1915



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## LETTER OF TRANSMITTAL.

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF BIOLOGICAL SURVEY,  
*Washington, D. C., March 26, 1915.*

SIR: I have the honor to transmit herewith, for publication as North American Fauna No. 38, a review of the American moles by Hartley H. T. Jackson, assistant biologist, Biological Survey. Widely distributed throughout a large part of North America and very numerous in many places, moles have in some localities proved injurious to agriculture, though they are generally beneficial through their destruction of insects, which form much of their food. Their economic status has not yet been fully determined but is now being carefully investigated by this bureau, and for this work the present paper will serve as a basis.

Respectfully,

HENRY W. HENSHAW,  
*Chief, Biological Survey.*

Hon. DAVID F. HOUSTON,  
*Secretary of Agriculture.*

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## A REVIEW OF THE AMERICAN MOLES.

By HARTLEY H. T. JACKSON.

### INTRODUCTION.

On account of their subterranean and secretive habits, American moles apparently were not observed by the earlier American explorers. As the settlement of the United States progressed, however, these animals became well known, and in many cases proved injurious to agriculture. Moles occur rather generally in eastern North America along the Atlantic and Gulf coasts from Labrador to Florida and in northeastern Tamaulipas, Mexico, and range westward to Manitoba and northeastern Colorado. Within this area are found three genera, *Scalopus*, *Parascalops*, and *Condylura*. All three genera occur in some localities, but no one covers the entire region occupied by the group. West of the area mentioned no moles are found until the Pacific coast region is reached. There, two other genera, *Scapanus* and *Neurotrichus*, occur, their ranges being confined mainly to the humid and semihumid region west of the Cascade Range and the Sierra Nevada, from southern British Columbia to northern Lower California.

In general, the several genera have the following distribution:

*Scalopus*, comprising the common naked-tailed moles of eastern United States, is the most widely distributed and best-known genus of the family. It ranges from southern Massachusetts, southern Ontario, central Minnesota, and northeastern Colorado south to the Gulf States and northeastern Tamaulipas, Mexico. It is confined almost entirely to the Upper and Lower Austral Zones.

*Parascalops*, comprising only a single species—Brewer's, or the hairy-tailed mole—is much more restricted in range than *Scalopus*, occurring from southern New Brunswick to northeastern Ohio, southern Pennsylvania, and south along the Appalachian Mountains to North Carolina. Although living in the midst of the range of *Scalopus*, in reality the two occur together at comparatively few

places, since *Parascalops* is confined exclusively to the Transition and Canadian Zones, while *Scalopus* inhabits chiefly the Austral Zones.

*Condylura*, also comprising only a single species—the star-nosed mole—is widely distributed, but apparently not very abundant. It ranges from southern Labrador and southeastern Manitoba south to northern Illinois, along the Appalachian Mountains to western North Carolina, and on the Atlantic coast to Georgia. Apparently not limited in its distribution by zones, it occurs from the Boreal to the Lower Austral.

*Scapanus* fills the place on the Pacific coast occupied by *Scalopus* on the Atlantic slope, being abundant and widely distributed from British Columbia south to northern Lower California. It ranges through all the zones from Boreal to Lower Sonoran.

*Neurotrichus* has a limited distribution on the Pacific coast west of the mountains from southwestern British Columbia south to Monterey County, California, occurring in the Boreal and Transition Zones.

#### HABITS AND ECONOMIC STATUS OF MOLES.

While all American moles have certain general habits in common, as, for example, spending most of their lives underground and feeding largely upon insects, their habits vary in details. The genera *Scalopus*, *Scapanus*, and *Parascalops* usually inhabit drier soils, burrow deeper, and confine themselves more to subterranean runways than do *Condylura* and *Neurotrichus*. All moles prefer loamy or sandy soil where burrowing is easier, and consequently they are scarce or absent in heavy clay, stony, or gravelly soils. Insufficient food is often the cause of their scarcity in excessively sandy soils.

The common mole (*Scalopus*) is found in almost any area where soil and food are suitable; it is most plentiful in meadows, gardens, and similar habitats, but is by no means confined to them, and frequently is found in open woodland, along the banks of streams, and in other environments. It dwells in a series of subterranean tunnels 10 to 18 inches beneath the surface, and from these it forces to the outside small piles of earth, scarcely large enough to be worthy the name "molehills." A second series of tunnels is made just beneath the surface of the soil and appears as a series of small ridges, usually more or less branching and at times ramifying in all directions. This second series seems to be made chiefly during the animal's hunt for food and may be occupied but once; generally, however, the main surface tunnels are used for a considerable time. During dry weather the mole works deeper and practically deserts the surface ridges. Its change of habit is due in part to the increased hardness of the surface soil, but undoubtedly is more the result of its pursuing worms and

insects into moister regions. Essentially the same condition is produced during winter, when the surface soil is frozen. The common mole seldom leaves its tunnels. Its nest is about 5 or 6 inches in diameter and usually 12 to 18 inches beneath the surface; most frequently it is placed under roots of shrubs or pasture grass and is made of grass and rootlets, but occasionally partly of leaves. In the northern half of its range the young are born during March or April; in the southern part they appear earlier in spring. The number of young in a litter varies from two to five, the usual number being four, and there is probably only one litter produced each year.

The habits of *Scapanus* are much like those of *Scalopus*. The ridges formed by *Scapanus* upon the surface are usually more conspicuous than those of *Scalopus*, and its "molehills," thrown up at frequent intervals, much larger. The hills made by *Scapanus* often contain a half bushel or more of dirt and resemble those made by the pocket gopher. The mounds made by *Scapanus*, however, show no trace of an opening, while those of the pocket gopher do. The mounds of *Scapanus* in most cases are more nearly circular than those of the pocket gopher. So far as known, the breeding habits of subspecies of *Scapanus latimanus* do not differ essentially from those of *Scalopus*; the time of breeding and the number of young in a litter are about the same. With *Scapanus townsendii*, however, the breeding time is later, the young usually being born during May or June. The number in a litter is less than with *S. latimanus*, there being usually only two or three, seldom four, and not infrequently only one.

The habits of *Parascalops* are not well known, but in general they appear to be much the same as those of *Scalopus*.

Star-nosed moles, genus *Condylura*, prefer to make their homes in wet meadows or marshes, though occasionally they may choose the same habitat as *Scalopus*, or even occupy the same tunnels with them. The surface ridges made by *Condylura* are more irregular and broken than those of *Scalopus* and usually smaller and more crooked; the burrows seem to be deep for a short distance, then appear as surface ridges, shortly to disappear again. Besides the subterranean tunnels, the star-nosed mole uses surface runways under and through the grass in marshes and meadows. Unlike other moles, *Condylura* frequently leaves its tunnels in winter and burrows in the snow, or even runs on top of it. Little is known concerning the nesting and breeding habits of this genus. A family of five young about one-third grown, collected May 22, 1888, by Morris M. Green, and now in the Biological Survey collection, was found in a nest under a log on the flats of the Potomac River a short distance north of Georgetown, D. C. Two of the young from this family are slightly more developed than the others, but it is not known whether



this is due to difference in time of birth or to subsequent conditions. Another nest, containing young, is described by Bishop as follows:

On May 22, 1890, while having some apple trees planted, I had the good luck to find a nest containing four young.

The locality where the nest was found was two miles south of Kentville in Kings County, Nova Scotia. The land had been cleared of small forest trees several years before and had grown up with grass and was mowed every year.

The particular spot where the nest was found was a little hillock or cradlehill which had been formed apparently by a tree having been blown down. When the roots had rotted away, a small dry mound of soft black sedimentary earth was formed, and in this the nest was built. This mound was high enough to be out of reach of storm water during wet weather.

The elevation containing the nest was ten inches below the surface, and was made in circular form, seven inches in diameter. The nest was built of old dry grass; and was very compact and neatly made. Although the mound contained a complete network of roadways, no earth was thrown to the surface within ten feet of the nest.<sup>1</sup>

The little *Neurotrichus* prefers a damp habitat and is seldom found far from swamps, marshes, or streams. In the extreme southern part of its range it is most frequently found in swampy places overgrown with sedges or shrubs. Farther north its habitat is less confined, and it is found along streams or even in moist dense woods. Its tunnels are more like those of *Condylura* than other moles, and it seems to spend no small part of its time in surface runways or under logs. In fact, the tunnels are often open above for some distance, and in this respect resemble the tunnels of the eastern pine mouse (*Pitymys pinetorum*). The nesting and breeding habits of *Neurotrichus* are unknown.

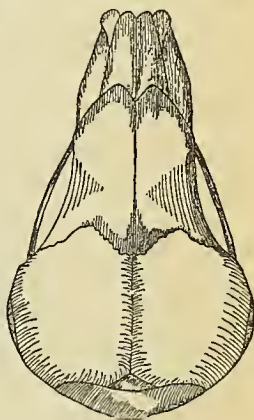
The economic status of American moles has been the subject of much dispute, authorities differing as to whether the animals are beneficial or harmful. The genera *Parascalops*, *Condylura*, and *Neurotrichus* are local in distribution, seldom abundant in any locality, and most frequently inhabit waste or uncultivated lands; they can not, therefore, have extensive economic importance. Such is not the case, however, with *Scalopus* and *Scapanus*, which are more generally distributed throughout their ranges, and usually abundant in lawns, fields, and gardens. The food of moles consists in large measure of insects, and in this they are beneficial. However, moles destroy large numbers of earthworms, make unsightly ridges in lawns, and dig tunnels which permit incursions of rodents injurious to roots, tubers, and planted seeds, and which frequently are directly responsible for the weathering away of humus deposits and super-soils on hillsides; in these activities moles are harmful. The economic status of the mole is being extensively investigated by Theodore H. Scheffer, under the direction of the Biological Survey; the results of his studies will be published later.

<sup>1</sup> Bishop, W. L., Trans. Nova Scotia Inst. Sci., vol. 10. pp. 348-349, October 1, 1902.

## CHARACTERISTICS AND DEVELOPMENT OF THE YOUNG.

The young of *Scalopus* (Pl. I, fig. 3) are born hairless. Vibrissæ very soon appear on the lips, but hair does not show until the animal is at least a week or ten days old. The fresh, first pelage remains short and grows little until the animal is nearly one-third grown; it is exceedingly fine and silky, and lies close to the body, giving the animal a smooth, sleek appearance. Two young,<sup>1</sup> probably about a week old, from Jackson, N. C., have the general proportions of the body much as in adults. The feet, both fore and hind, have much the same shape as in adults, and are relatively about the same size, though, on account of the bones of the arm thickening rather than lengthening during growth, the fore feet of the young, being relatively more projected from the body, appear at first glance to be relatively very large. The hind feet are relatively a little wider than those of adults. The claws of the fore feet are soft and weak, though relatively thick and broad; those of the hind feet are very soft and only slightly developed. The external ear appears as a thickening of the dermis into a flat papilla 1.5 mm. in diameter. The center of this is penetrated by a minute auditory opening that seems to be closed by the contact of its sides; as an auditory organ its function is probably exceedingly limited. The rudimentary eye appears as a small pigmented spot covered by dermis; a minute, imperfect opening passes through the dermis to the eye proper, and may be sufficiently penetrable for the animal to perceive light from darkness; it seems improbable, however, that the eye is sufficiently developed for form perception, and it is probable that with advanced age the sense of light perception becomes less acute.

Skulls of young (fig. 1) a week or ten days old distinctly show the sutures between the principal cranial bones; the sutures between the frontals and parietals, however, are now nearly closed. In comparison with skulls of adults, the mastoid region is high and swollen and the zygomata are heavy. The auditory meatus is distinct and more pronounced than in adults, the bullæ small, but relatively high and rounded and not so much flattened. The nasals are short and broad, becoming wider posteriorly; the premaxillæ are triangular, adjoining the anterior two-fifths to one-half of the nasals. During the development of the skull the premaxillæ push forward



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FIG. 1.—Skull of young of *Scalopus aquaticus machrinoides* (X 3). [Reconstructed and drawn by the author from specimens Nos. 5899 and 5900, Field Mus. Nat. Hist.; from Greenway, Ark.]

<sup>1</sup> Alcoholic, No. 7250, U. S. Nat. Mus.



and gradually enclose the nasals anteriorly. Most of the cranial bones are anastomosed and the sutures closed before permanent dentition is acquired. The suture between the interparietal and the parietals is the last to close and is the only one which may remain open and distinct in extreme old age. The sutures between the premaxillæ and the maxillæ and those between the nasals and the maxillæ usually remain indistinctly visible until permanent dentition is acquired.

The writer has examined no very young moles of genera other than *Scalopus*, but it would seem that the general relationships of characteristics of young to those of adults would be essentially the same in the different genera. Bishop, writing about *Condylura*, states: "The young were probably ten days old, the fur just beginning to start, which gave the skin a dark brown colour."<sup>1</sup> The most remarkable difference between young and adults of *Condylura* is in the snout. The character of that organ in the young has been well described by Ayres, as follows:

At birth the star-nosed mole is nearly destitute of visible hair and the tactile bristles of the facial region have not made their appearance at the surface. The snout of the young *Condylura* lacks all the distinctive characteristics of the adult, and the entire body resembles that of *Talpa* much more than it does its parent. On a close examination of the distal end of the snout of such a new-born animal one can distinguish a tract of skin which covers four-fifths of the circumference of the organ (the part not specially marked off is the median ventral fifth). This dermal tract extends for three millimeters toward the base of the snout and is marked off from the remaining surface by a series of furrows running parallel to the long axis of the body. A series of parallel ridges is thus formed, each ridge being bounded on either side by a furrow. At their anterior and posterior ends these ridges pass gradually into the neighboring smooth surface. By a gradual ingrowth of the bottoms of the furrows each groove is deepened and each ridge suffers a correspondingly increased definition of form, while at the same time the posterior end of each groove grows toward its neighbor on either side. When the grooves have all united there is formed by their union a common groove which nearly encircles the snout and separates the tactile from the remaining surface of that organ.

Commencing at the posterior margin of the tactile surface and advancing toward the tip of the snout, the grooves deepen and grow toward each other in their bottom portions until they finally coalesce underneath the ridges. The result of this process is the production of free, finger-shaped processes composed exclusively of ectoderm, attached to the anterior end of the snout in the manner already described for the adult.<sup>2</sup>

The pelage of individuals of *Scapanus*, *Parascalops*, and *Condylura*, one-third grown, has much the same compact, sleek appearance as that of *Scalopus*, indicating a slow and probably entirely postnatal growth.

<sup>1</sup> Bishop, W. L., Trans. Nova Scotia Inst. Sci., vol. 10, p. 349, Oct. 1, 1902.

<sup>2</sup> Ayres, H., Biol. Centralb., band 4, pp. 358-359, 1885.



## PELAGES AND MOLTS.

The hair of all American moles is fine and silky, producing a soft and velvetlike pelage. In *Scalopus*, *Scapanus*, and *Parascalops* the hairs are nearly equal in length and there is no distinct underfur. In *Condylura* some of the hairs are distinctly longer and coarser than the major portion, the latter forming an underfur, and the whole producing a pelage much less velvetlike than that of any other genus. In *Neurotrichus* the condition of the pelage is somewhat as in *Condylura*; the fur is shorter, however, and the underfur difficult to detect.

The basal pelage reveals a series of transverse vermiculations, most pronounced in *Scalopus* and *Scapanus*, least in *Neurotrichus*; in all genera these markings are more noticeable in the fur on the back, less on the ventral parts. Microscopic examination shows that these vermiculations are due to structural as well as chromatic differences. Each hair consists of normally pigmented, gray, cylindrical sections, 1 to 2 mm. long, alternated with finer flat sections, 0.2 to 0.5 mm. long and unpigmented, or with the pigment reduced to a small amount of yellow. Each one of these fine, flat sections acts as a hinge upon which the hair bends; this in part produces the velvetlike texture of the pelage and permits the hair to be rubbed either forward or backward with little friction—a distinct advantage to a subterranean mammal. The vermiculations usually show more clearly in worn pelage than in fresh. The young of *Scalopus*, *Scapanus*, and *Parascalops*, in their first winter pelage, are more grayish than adults; of *Condylura*, paler and more brownish. Winter pelage of adults of all moles is usually darker than that of summer; worn pelage is faded and frequently more brownish than the fresh. The color of specimens retained in a cabinet or storage case for a few years usually fades, becoming more brownish than that of recently killed animals.

## TIME OF MOLTING.

There are two molts annually in *Scalopus*, one in spring and the other in fall. Throughout most of the range of the genus the spring molt is usually completed by the last of May or the first of June; the fall molt, in the northern half of the range, by the first week in October; in the southern part of the range the fall molt naturally occurs later in the year, and the spring molt earlier than farther north. The winter pelage of breeding females becomes worn early in the season, but, as has been suggested by True,<sup>1</sup> the actual molting in such individuals may frequently be delayed. Examination of a large series of specimens from Washington, D. C., shows that

<sup>1</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 37, 1896.

the spring molt in that region occurs usually during the months of April and May, though most of the animals are probably in full summer pelage by the middle of May. A large series of specimens from the same locality, taken during October and the first part of November, are all in full winter pelage; the fall molt seems to take place there during the latter part of August and the first half of September. Specimens of *Scalopus aquaticus machrinus* from northern Illinois show molting during the first half of May; one taken June 15, 1907, at Joliet, Ill., is in fresh summer pelage, except for a small place on the face; in a topotype of *S. a. machrinus* collected September 5, 1898, the ventral parts are in short, fresh, winter pelage, the dorsal parts in old, summer pelage. Specimens of *S. a. pulcher*, taken at Delight, Ark., the middle of September, are in nearly complete winter fur; an adult male taken April 30, 1910, at Lake City, Ark., is in fresh summer pelage except on the nose; specimens taken at Sour Lake, Tex., the latter part of March and first of April, 1905, show the beginning of molt on the underparts. The spring molt of *S. a. australis* seems to occur from about the middle of March to the middle of April. A topotype of *S. a. texanus*, collected February 9, 1893, has fresh summer pelage on the abdomen.

The time of molting seems to be more irregular in *Scapanus* than in *Scalopus*, and the period of seasonal molt during which numbers of individuals may be found molting is more prolonged than with *Scalopus*; it is possible that this difference may be correlated with climatic differences. The spring molt in *Scapanus latimanus latimanus* may commence any time from the middle of January to the last of April; specimens in which the spring molt has just begun were collected at Santa Cruz, Cal., January 14 and February 28, and at Red Bluff, Cal., April 24; one collected at Lower Lake, Cal., April 12, still retains the worn and faded winter pelage; a specimen collected March 13, at Santa Cruz, is in fresh summer pelage, and the majority of specimens show this condition by the middle of April. The autumnal molt of *S. l. latimanus* may begin from the middle of August to the last of November; in a male collected August 14, at Santa Cruz, the molt is well begun; a specimen taken November 30 at Fort Bragg, Cal., has fresh pelage on the head only, and another taken the same day at King City, Cal., has obtained about one-third of its new pelage; in most cases, however, the winter pelage is complete by the last of November. The autumnal molt in *S. l. dilatatus* is usually completed a month earlier than in *S. l. latimanus*, though one specimen collected at Chico, Cal., December 20, has just started to molt. A female collected August 4, at Round Mountain, Cal., is about two-thirds covered with fresh pelage, and is probably in a delayed spring molt. The specimens of *S. l. occultus* examined indicate that the spring molt in that form may begin as early as the first



of January or as late as the latter half of June; a specimen in which the molt is just begun was collected January 2 at Somerset, Cal., and a male in similar condition of molt was taken at Alhambra, near by, on June 21; spring molt in *S. l. occultus* is usually completed by the first of April and the autumnal molt about the first of December. The material available does not show many specimens of *S. townsendii* in process of spring molting; two collected April 7, 1914, at Puyallup, Wash., are in nearly complete summer pelage, while in three others the molt is fully complete. The majority of specimens show full summer pelage the latter part of April. The fall molt of *S. townsendii* occurs most frequently during October; specimens occasionally show molting later in the year, as, for example, one collected December 20, 1912, at Ferndale, Cal., which shows the last remnants of summer fur; on the other hand, the fall molt may begin as early as the latter part of August; several females collected during July and the first half of August, near Portland, Oreg., are in various stages of molting from the beginning to half complete, which may be a delayed spring molt. A specimen of *S. orarius orarius* collected March 11, 1913, at Ferndale, Cal., has begun to molt; one of *S. o. schefferi* collected at Lester, Wash., May 14, 1914, shows only a trace of old pelage on the back and underparts; others secured the middle of May are in full summer pelage. The change to winter pelage in *S. o. orarius* seems to occur mostly during October, though a male taken at Eureka, Cal., August 17, 1910, shows the beginning of the autumnal molt.

Material examined is insufficient for a satisfactory determination of the time of molting of *Parascalops*; in a male from Magnetic City, N. C., collected March 26, 1894, the ventral parts and the rump are in fresh summer pelage, the rest of the fur being worn winter pelage; other specimens in various stages of molt from the same locality were taken between April 24 and July 5. Many specimens collected at various localities during August and September show a much-worn pelage; it seems probable that winter fur appears during October and November; in fact a specimen collected October 12, 1910, in Wetzel County, W. Va., has traces of a new pelage under the old on the breast. An adult male from Magnetic City, N. C., collected August 21, 1893, shows molting and has the entire ventral parts in fresh pelage; it is impossible to determine whether this is an early fall molt or a delayed spring molt.

The spring molt in moles of the genus *Condylura* occurs late, the molting process being at its height during June and the first half of July, though it is usually completed by the middle of the latter month; very rarely molting may begin during the last few days of May, and, equally as rarely, traces of winter pelage may remain well into August. The autumnal molt of *Condylura* takes place

during October, though occasionally it begins the last of September; the full winter pelage is usually obtained before the last of October.

In a large series of *Neurotrichus* from Sumas, British Columbia, the spring molt appears to be at its height during the latter half of May and the first week of June, though one or two specimens indicate a beginning of the molt as early as the latter part of April; most individuals are in full summer pelage by the first of July; none of these specimens show autumnal molt. Farther south, in Washington, Oregon, and northern California, spring molt is earlier, and specimens taken there during the first part and middle of June are in summer pelage. The available material has been insufficient to determine the time of the fall molt, though apparently it occurs during October. A specimen from Goldbeach, Oreg., collected September 21, 1901, has a trace of new pelage under the old on the breast; two from Steilacoom, Wash., October 9 and 12, 1891, and one from Palo Alto, Cal., October 17, 1897, have the molt well advanced; a male taken October 18, 1891, at Tenino, Wash., is in nearly complete winter pelage.

#### MANNER OF MOLTING.

Molting in *Scalopus* occurs more or less regularly in definite sequence on the different parts of the body, and the same order is followed in both the vernal and autumnal molts. The fresh pelage first appears on the breast and abdomen (Pl. I, fig. 1) and gradually replaces the old until the entire underparts, except the chin and throat, have molted; at this stage there is a sharp lateral line of demarcation between the new and the old fur (Pl. I, fig. 2); the fresh pelage gradually extends up over the back, generally encroaching upon the posterior part first and working forward toward the nose. The chin and throat in most individuals retain the old pelage for several days after all the rest of the molt is complete. There are, of course, exceptions to this general order of molting but most of these occur in animals which are molting either earlier or later than normally, and the writer is inclined to believe that these variations are either due to retarded or stimulated physiological processes, or else result from injuries to the animal. Two specimens show distinctly that the molting process has been retarded on account of injuries; one<sup>1</sup> is in full winter pelage except a very small place on the throat and a small patch directly posterior to a flesh wound on the left side of the posterior part of the back; the other<sup>2</sup> is in complete winter pelage except a circular patch, about 20 mm. in diameter on the occiput, which is also mostly posterior to a flesh

<sup>1</sup> No. 180703, U. S. Nat. Mus., Biological Survey collection; ♂ adult, collected at Washington, D. C., October 11, 1912.

<sup>2</sup> No. 6190, Acad. Nat. Sci. Philadelphia; ♀ adult, collected at Audubon, N. J., October 28, 1908.



wound and partly encloses it; winter pelage surrounding the patches is in both specimens long and well developed, in marked contrast with the short fur of delayed growth. A male<sup>1</sup> from Connecticut, in somewhat premature molt, has the entire dorsal parts in fresh pelage except a patch about 30 mm. in diameter on the right shoulder; the anterior three-fifths of the ventral parts are in old pelage, and this extends well up the sides. A postbreeding female,<sup>2</sup> the molting of which has already been mentioned by True,<sup>3</sup> is in retarded, much-worn winter pelage, except the posterior half of the back, anterior to the rump, and a very small portion of the abdomen, which are in rather incomplete spring pelage.

The sequence of molting in *Scapanus* is less definite than in *Scalopus*. The differences of color, texture, and length of hair between the old and new pelages of *Scapanus* are usually slight; often the line of demarcation separating the two pelages is scarcely distinguishable, and seldom sharp as in *Scalopus*. The sequence of molting on the various parts of the body appears in a few cases to be not unlike that of *Scalopus*, the underparts molting first, followed consecutively by the sides and back. More frequently, however, the new pelage appears first on the head and throat, then works down over the nape and back, encroaching last upon the abdomen; or, as is shown most beautifully in a specimen<sup>4</sup> of *Scapanus latimanus latimanus* from Petrolia, Cal., the new pelage may appear simultaneously in separate patches upon head, back, and rump.

The material has been inadequate to show anything definite regarding the method and sequence of molting in *Parascalops*, but the specimens examined seem to indicate that these processes are not unlike corresponding processes in *Scalopus*.

The new fur of *Condylura* generally appears first on the posterior part of the flanks, but the body sequence is inconstant; the molt on the flanks usually spreads forward and ventrally, while at the same time on the back fresh pelage replaces the old, which sloughs off in irregular blotches. Probably in most cases the ventral parts are in fresh pelage before the major portion of the back has molted; a small posterior rump patch is almost invariably the last to molt. The contrast between new and old pelages during the spring molt is marked; the autumnal molt, however, is often difficult to detect.

In the genus *Neurotrichus*, new pelage ordinarily first replaces the old on top of the head; this is soon followed by the molting of the posterior part of the back almost simultaneously with the beginning

<sup>1</sup> No. 4276, Mus. Comp. Zool., Bangs collection; ♂ adult, collected February, 21, 1896, at Liberty Hill, Conn.

<sup>2</sup> No. 22858, U. S. Nat. Mus., Biological Survey collection; collected July 1, 1888, at Washington, D. C.

<sup>3</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 37, 1896.

<sup>4</sup> No. 140706, U. S. Nat. Mus., Biological Survey collection; ♂ adult, collected Nov. 6, 1905.

of the molting of the ventral parts on the throat and breast; the molting areas on the back increase in size and finally enclose each other; the area on the breast works posteriorly, then dorsally; the flanks are the last to molt. The molting process in *Neurotrichus*, once well begun, seems to be very rapid, and this may account for the sparsity of material of this genus showing molt.

#### GEOGRAPHIC VARIATION.

The maximum of geographic variation occurs in *Scalopus* and *Scapanus*. In *Scalopus* it consists in general of a decrease in size toward the south and an increase in pallor toward the west. The maximum size of individuals is found in the north-central part of the range of the genus; the size decreases gradually both to the east and west, and rather abruptly toward the south. The rostrum tends to shorten in the western and southwestern portions of the range. The palest members of the genus are found in the region of western Nebraska; the color darkens toward the east and south, becoming somewhat ochraceous in the southwestern part of the range.

The size of *Scapanus* (except in *S. townsendii* and *S. orarius orarius*), like that of *Scalopus*, decreases toward the south. In the coast region the pallor increases toward the south, and reaches its maximum in specimens of *Scapanus latimanus occultus* from San Diego County, Cal.; farther south, however, in the San Pedro Martir mountain region of Lower California, the color of *Scapanus* seems to become darker again. In the interior, more mountainous regions, the color of *Scapanus* becomes darker toward the south, the darkest specimens being from Yosemite Valley, Cal., while the palest are from Crater Lake, Oreg., and the Mount Shasta region, Cal.

Geographic variation in *Neurotrichus* manifests itself in a slight increase in size and a very slight darkening of color in the southern part of the range. A tendency appears also for the more pronounced development of an anterior cusplike process on the cingulum of the second upper premolar in specimens from the southern half of the range of the genus.

Geographic variation in *Parascalops* and *Condylura* is negligible, though a slightly decreasing size southward is noted in *Condylura*.

#### INDIVIDUAL VARIATION.

The general size, shape, and proportions of skulls of moles, conspecific and of corresponding maturity, from any given locality are usually constant, variation seldom exceeding more than 4 per cent. On the other hand, the shape of individual cranial bones is noticeably variable, especially that of the interparietal. In a series of specimens of *Scalopus* from a given locality the posterior border of the palate



may be simple, spined, or notched; in *Scapanus*, simple, but usually notched; in *Condylura* usually simple, but sometimes spined; and in *Parascalops* and *Neurotrichus*, almost invariably simple. There is a marked tendency in *Scalopus* and *Scapanus* toward abnormal dentition; this appears not only in the production of accessory cusplike processes on the cingula of the premolars, but also in the increase or reduction of the number of premolars ordinarily present. The tendency in *Scalopus* is toward extra premolars; in *Scapanus* it is toward the suppression of premolars, though in each of at least seven skulls examined there is a supernumerary premolar.

The general color of specimens from a given locality is constant, except for seasonal variations. Individual abnormalities, however, occur frequently in *Scalopus* and *Scapanus*. The common type of chromatic variation in *Scalopus* is the occurrence of white, cream, orange, or ochraceous spots or blotches, appearing usually either on the face or on the ventral parts. Scheffer<sup>1</sup> has remarked upon the prevalence of this form of variation in *Scalopus* at Manhattan, Kans., where he finds that certain regions of the body of a large majority of the moles taken are washed with a tinge of orange, or that on the head or abdomen are distinct patches of this color. Variations similar to these, however, crop out in many localities. They are not confined to any particular species or subspecies, but appear most frequently in *S. a. machrinus* and *S. a. machrinoides*. In many specimens this form of variation is, apparently, partial albinism, the patches being nearly white and the slight creamy or brown tinge probably being due to glandular or other stains. Blotches in other specimens range from cream color to shades of buff, orange, and brown, and show clearly that they are due to mutations of color. A unique variation occurs in a specimen from Warsaw, Ill. (No. 5429, American Museum of Natural History). The entire underparts of this animal, except the vent and right hind foot, are a beautiful capucine buff, as are also the nose and right side of the face; a narrow band of this color extends for a short distance up the posterior part of each flank, and anteriorly another band passes over the shoulders and across the nape, forming a complete collar; the remaining dorsal parts are much as in normal specimens, but perhaps slightly more vinaceous. Another peculiar variation occurs in a specimen from Madison, Ind. (No. 112008, United States National Museum). The entire dorsal parts of this individual are normally colored; the ventral parts are pale ochraceous-salmon to ochraceous-buff, irregularly spotted and blotched especially laterally with grayish fuscous, the whole effect reminding one in certain respects of the ventral parts of some of the spotted tiger-cats or ocelots.

<sup>1</sup> Scheffer, T. H., Kansas State Agr. College Exp. Sta. Bul. 168, p. 4, 1910.

That these chromatic mutations are inherited in Mendelian ratio among the offspring is strongly suggested in the specimens examined from Point Pelee, Ontario. From the small and somewhat isolated colony of *Scalopus* inhabiting this locality 25 specimens collected between October 18, 1908, and June 2, 1913, have been examined. Of these specimens 18 have ochraceous patches on the face, while the remaining 7 are normally colored. On purely unsubstantiated evidence, it would appear that "lack of gray-producing pigment" is here a dominant character, and that the hereditary tendency is probably toward pattern development rather than toward the primitive mammalian monochromatic grayish coloration.

Mutations of color seem to occur less frequently in *Scapanus* than in *Scalopus*; they are most marked in specimens of *Scapanus orarius schefferi* from Walla Walla and Wenatchee, Wash. Abnormalities in color in the genera *Parascalops*, *Condylura*, and *Neurotrichus*, are confined to albinistic spots which occur only rarely and usually appear to have been caused by injuries.

The writer has seen no melanistic specimens of American moles.

#### SEXUAL VARIATION.

The only marked sexual variation in American Talpidæ is in size of individuals. This is very noticeable in *Scalopus* and *Scapanus*, in which genera males are considerably larger than females. The same condition probably holds in other genera; in the specimens examined of *Parascalops*, *Condylura*, and *Neurotrichus* there is no apparent sexual variation, but this may be due to incorrect determinations of sex.

#### AGE VARIATION.

The most characteristic change in American Talpidæ occurring with increasing maturity is a flattening of the skull and a broadening of the base of the rostrum. These tendencies prevail in all genera. Broadening of the base of the rostrum is due to lateral thickening of the maxillæ. In immature specimens the external roots of the molars are not infrequently exposed in places through the maxillæ. In all genera except *Condylura* the upper premolars tend to become less euspidate with increasing age, due not alone to wear of the teeth, but apparently to absorption and physiological processes.

The genus *Condylura* furnishes an anomalous and unique age variation; old adults possess a distinct median longitudinal crest on the upper posterior half of the rostrum. Another peculiar variation accompanying age occurs in *Parascalops* in which the hair on the nose and tail frequently turns white in old adults.



## SEASONAL VARIATION.

Winter pelage of most moles is slightly darker than that of summer. No other seasonal variations occur except in *Condylura*: The tail of *Condylura* during the summer months is narrow and elongate; during the winter months it becomes much thickened, abruptly constricted at the base, and tapered apically. Both males and females have been found with tails in both conditions. The variation probably is due to assimilation of fat. Enlargement of the tail may begin as early as August, but usually it does not begin until September, or possibly later; the maximum size is reached in most cases by the latter part of November and is retained until March or April, when the tail gradually diminishes to its minimum summer size by the last of May or the middle of June.

## EXPLANATIONS.

## EXTERNAL MEASUREMENTS.

External measurements of moles are in millimeters and, unless otherwise stated, are those made by the collector from the animal in the flesh. The following have been used:

*Total length*.—Tip of nose to end of terminal tail vertebra.

*Tail vertebrae*.—Base of tail at upper surface to end of terminal tail vertebra.

*Hind foot*.—Heel to end of longest claw.

## CRANIAL MEASUREMENTS.

Cranial measurements were made by the author with a vernier caliper. The following have been employed:

*Greatest length*.—Antero-posterior diameter of skull from anterior median point between bases of first upper incisors to most posterior point of supraoccipital in median line.

*Palatilar length*.—Antero-posterior diameter of palate from posterior median point between bases of first incisors to posterior median border of palate.

*Mastoidal breadth*.—Lateral diameter of skull measured through mastoids. Greatest lateral diameter of skull.

*Interorbital breadth*.—Lateral diameter of cranium measured at coronal suture.

*Maxillary tooth row*.—Antero-posterior diameter of upper molar-premolar row measured at alveolar border.

*Mandibular molar-premolar row*.—Antero-posterior diameter of lower molar-premolar row measured at alveolar border.

The bone immediately anterior to the lambdoidal crest and just posterior to the parietals is here called the "interparietal." This bone in moles has been considered by some writers part of the supraoccipital.

## COLORS.

The names of colors used throughout the text are those of Ridgway.<sup>1</sup> On account of iridescence and reflection of light from the fur the color of any single animal may appear to vary considerably when viewed from different angles. For this reason the following method of making comparisons and observations of colors was used consistently: Diffused daylight from a window was allowed to strike the animal at an angle of 30° to 45° posterior to a plane perpendicular to the median longitudinal line of the animal. The mole was then viewed from its anterior end at an angle of about 60° from the light rays and in the same plane with them. In spite of this care colors have sometimes been exceedingly difficult to determine and describe.

## MATERIAL AND ACKNOWLEDGMENTS.

The present revision recognizes 28 forms of 10 species of American moles and is based upon a study of 2100 specimens, mostly skins accompanied by skulls. Of this number, *Scalopus* comprised 945, *Scapanus* 604, *Parascalops* 129, *Condylura* 218, and *Neurotrichus* 204. While type specimens or essential topotypes of all described forms have been examined, the material has been inadequate for an entirely satisfactory understanding of the group, and this is particularly true of the genus *Scapanus*, and of *Scalopus* from some of the southern and western parts of its range. Unreliable determinations of sex also have been a serious handicap.

Although the study has been based primarily upon specimens in the Biological Survey and other collections in the United States National Museum, including the Merriam collection, it became evident early in the investigation that this material would be insufficient for a proper elucidation of the group. Accordingly specimens were borrowed from various museums and private collections until nearly all that were available in the United States and Canada were examined. For the loan of specimens and for various other courtesies I wish to express my appreciation to the following: Dr. J. A. Allen, of the American Museum of Natural History; Mr. Samuel Henshaw and Mr. Outram Bangs, of the Museum of Comparative Zoology, Harvard College; Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology of the University of California; Mr. Charles B. Cory and Mr. W. H. Osgood, of the Field Museum of Natural History; Dr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia; Dr. W. J. Holland and Mr. W. E. Clyde Todd, of the Carnegie Museum; Mr. H. L. Ward, of the Public Museum of the City of Milwaukee; Dr. A. G. Ruthven, of the University of Michigan Museum

<sup>1</sup> Ridgway, R., Color Standard. . . and Color Nomenclature, 1912.

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### THE FAMILY TALPIDÆ.

The family Talpidæ, exclusive of fossil forms, is composed of thirteen genera peculiar to the temperate regions of the Northern Hemisphere.<sup>1</sup> Five of these (*Scalopus*, *Scapanus*, *Parascalops*, *Condylura*, and *Neirotichus*) are indigenous to North America. *Scapanus* and *Neirotichus* are found only on the Pacific slope; *Scalopus*, *Parascalops*, and *Condylura*, only in the Atlantic drainage. The family is a rather heterogenous group which, in certain genera, has characters in common with other families of Insectivora. The characters taken in combination, however, are diagnostic. The nearest relationships of the family are with the Soricidæ, which are approached most closely in the Thibetan genus *Uropsilus*. The American Talpidæ, however, are distinct from any of the American Soricidæ and may be distinguished by the following characters:

#### AMERICAN TALPIDÆ (MOLES).

Ear-conch absent.

Clavicle short and broad.

Humerus short and broad (length less than twice the width).

Pelvis relatively narrow (length more than thrice the width).

Os falciforme present on the fore foot (rudimentary and indistinct in *Neirotichus*).

Terminal phalanges of fore feet bifurcate.

Zygomata present.

Audital bullæ present, complete or incomplete.

Exterior pterygoid region rotund and much inflated.

First upper incisor flat, without elongated crown.

#### AMERICAN SORICIDÆ (SHREWS).

Ear-conch present (small and inconspicuous in *Blarina* and *Cryptotis*).

Clavicle long and slender.

Humerus relatively long and slender (length more than twice the width).

Pelvis relatively broad (length less than thrice the width).

No os falciforme on the fore foot.

Terminal phalanges of fore feet simple, not bifurcate.

Zygomata absent.

Audital bullæ absent.

Exterior pterygoid region angular and not inflated.

First upper incisor not flat, with very elongated crown.

<sup>1</sup> A closely related family, Chrysochloridæ, is found in central and southern Africa.



## SUBFAMILIES.

Several mammalogists have undertaken to divide the Talpidæ into groups or subfamilies. The most recent classification of this sort is that of Thomas,<sup>1</sup> who divides the family into five subfamilies, namely, Desmaninæ, Talpinæ, Scalopinæ, Condylurinae, and Uropsilinae. The American genera *Scalopus*, *Scapanus*, *Parascalops*, and *Neurotrichus* would fall in the subfamily Scalopinæ, according to this arrangement, while the Condylurinae would be represented only in America by *Condylura*. Such a system of classification, however, is superficial and unnatural. The anatomical differences, other than dentition, between *Parascalops* or *Neurotrichus* and each of the other genera of American moles are as great as those between *Condylura* and each of the other genera or even greater. In other words, in order to recognize fundamental and consistent subfamilies it would be necessary to raise nearly every genus to the rank of a subfamily. The convenience of such a classification is not apparent, and accordingly subfamilies have been disregarded here.

## HISTORY.

No reference appears in literature to a mole inhabiting America until Seba,<sup>2</sup> in 1734, described and illustrated two mammals which he called "*Talpa, Virginianus, niger*" and "*Talpa, rubra, Americana*." Seba, apparently erroneously, gives "America" as the habitat of each of these animals. His figure and description of *Talpa virginianus niger* clearly indicate that *Talpa europæa* Linnæus was the animal in mind. It is impossible definitely to determine the current species to which his name *Talpa rubra americana* refers; probably he had reference to a specimen of the African genus *Chrysochloris*, but it is possible that he based his account upon a verbal description of some species of the American genus *Geomys*. The essentials of his description of *Talpa rubra americana* refer to the red color, the short, white, scantily haired tail, and the "tridactyle" fore feet. Nevertheless, his account shows that the presence of moles in America probably was suspected at that time. The first definite knowledge of their occurrence seems to have been obtained by Kalm,<sup>3</sup> who, October 28, 1748, saw burrows and runways of moles near Philadelphia, Pa. He captured one of the animals, and remarked upon its strength and ferocity.

Linnæus,<sup>4</sup> in 1758, described two American moles under the names *Sorex aquaticus* and *Sorex cristatus*, basing his accounts largely upon Kalm's work. During the century following Linnæus's descriptions

<sup>1</sup> Thomas, Oldfield, Ann. & Mag. Nat. Hist., series 8, vol. 10, p. 297, October, 1912.

<sup>2</sup> Seba, A., Locupletissimi Rerum Naturalium Thesauri, vol. 1, p. 51, pl. 32, 1734.

<sup>3</sup> Kalm, P., Beschreibung der Reise nach dem nördlichen America, vol. 1, pp. 190-191, 1759.

<sup>4</sup> Linnæus, Systema Naturæ, ed. 10, p. 53, 1758.



of these two forms, many papers on the habits, anatomy, and taxonomy of American moles appeared—the result of an interest aroused largely by the odd habits, specialized anatomy, and unknown relationships of the group. To discuss here these almost innumerable writings would be impracticable, and only the more important taxonomic revisions and synopses and the first usage of current generic names will be mentioned. All other generic, specific, and subspecific names will be discussed in their proper sequence.

The American Talpidæ were confused by early zoologists with the genus *Sorex* and the European genus *Talpa* until the year 1811, when Illiger based the genus *Condylura*<sup>1</sup> upon *Sorex cristatus* Linnæus, and the genus *Scalops*<sup>2</sup> upon *Sorex aquaticus* Linnæus. The generic name *Scalops* had been used previously by Cuvier<sup>3</sup> who, however, gave no description or type species. The name *Scalops* was generally used for the common mole of eastern United States until 1904, when Palmer<sup>4</sup> revived the accepted name, *Scalopus* Geoffroy,<sup>5</sup> which apparently had never been employed since proposed in 1803.

One of the first important treatments of a genus of American moles, other than accounts in books on general natural history, is given by Bachman,<sup>6</sup> who revised the genus *Scalops*, including therein the genera now recognized as *Scalopus*, *Scapanus*, and *Parascalops*. He remarked upon the morphology and distribution of *Scalops aquaticus* and *Scalops townsendii*, and described two new species under the names *Scalops breweri* and *Scalops latimanus*. All of these species are recognized in the present revision.

The genus *Scapanus* was proposed by Pomel,<sup>7</sup> in 1848, to include Bachman's two species, *Scalops townsendii* and *Scalops breweri*. The type of the genus *Scapanus* automatically became *Scalops townsendii* Bachman when True,<sup>8</sup> nearly fifty years after Pomel's publication, described the genus *Parascalops* and designated *Scalops breweri* Bachman as its type.

The genus *Scalops* was restored to the genus *Talpa* by Le Conte<sup>9</sup> in 1854, but his classification was not adopted by zoologists. He divided *Talpa* into three groups: under group 1 he included the European genus known to-day as *Talpa*; under group 2 the modern genera *Scapanus* and *Parascalops*; and under group 3 the genus now known as *Scalopus*. In his revision he described two new forms, one of which, *Talpa reposta*, is a synonym of *Parascalops breweri*

<sup>1</sup> Illiger, C., Prod. Syst. Mamm. et Avium, p. 125, 1811.

<sup>2</sup> Illiger, loc. cit., p. 126, 1811.

<sup>3</sup> Cuvier, G., Leçons d'Anat. Comp., vol. 1, tab. 1, 1800.

<sup>4</sup> Palmer, T. S., Index Generum Mamm., N. Am. Fauna No. 23, p. 620, Jan. 23 1904.

<sup>5</sup> Geoffroy Saint Hilaire, É., Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.

<sup>6</sup> Bachman, J., Boston Journ. Nat. Hist., vol. 4, pp. 26-35, January, 1842.

<sup>7</sup> Pomel, A., Archiv. Sci. Phys. et Nat., vol. 9, p. 247, November, 1848.

<sup>8</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

<sup>9</sup> Le Conte, Joseph, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, pp. 326-327, 1854.

(Bachman); the other, *Talpa tæniata*, is synonymous with *Scapanus townsendii* (Bachman).

The same year that Le Conte's revision appeared, a mole related to the Japanese genus *Urotrichus* was collected by George Gibbs in the Cascade Mountains of western Washington. This specimen later became the type of *Urotrichus gibbsii* Baird,<sup>1</sup> a species which subsequently became the type of the genus *Neurotrichus* Günther.<sup>2</sup>

In 1875 Gill<sup>3</sup> presented a synopsis of the Insectivora, in which he classified families, subfamilies, and genera, dividing the family Talpidæ into two subfamilies, Talpinæ and Myogalinæ. The Talpinæ were further subdivided into three sections, Talpæ, Condyluræ, and Scalopes; the Myogalinæ into the sections Mygalæ and Urotrichi. The American genus *Condylura* represented the section Condyluræ; *Scalops* and *Scapanus* (including also the form now known as *Parascalops*) represented the section Scalopes; *Urotrichus* (including also the present *Neurotrichus*) and the shrewlike *Uropsilus* formed the section Urotrichi.

Two years after Gill's synopsis was published there appeared a preliminary revision of the American Insectivora by Coues,<sup>4</sup> in which he listed six species of moles belonging to four genera.

Dobson,<sup>5</sup> in an extensive revision of the Insectivora published in 1883, gave detailed accounts of the taxonomic characters and anatomy of moles, recognizing five American species which he placed in four genera.

However, it was not until True's monumental revision<sup>6</sup> of the American moles, in 1896, that the distribution and taxonomic relationships of the group in America began to be understood. True recognized eleven forms, distributed among eight species of five genera, and described one new species, *Scapanus orarius*.<sup>7</sup>

#### LIST OF GENERIC NAMES THAT HAVE BEEN USED FOR AMERICAN MOLES.

**Astromycter** Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]). A synonym of *Condylura* Illiger. Based on an abnormally colored specimen of *Condylura cristata* with the tail in the enlarged winter condition.

**Astromyctes** Gray, List Spec. Mamm. Brit. Mus., p. 76, 1843. Misprint for *Astromycter* Harris (= *Condylura* Illiger).

**Astromydes** Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863. Misprint or emendation for *Astromycter* Harris (= *Condylura* Illiger).

<sup>1</sup> Baird, S. F., Reports Explor. & Surv. Pacific Railroad, vol. 8, part 1, p. 76, 1857.

<sup>2</sup> Günther, A., Proc. Zool. Soc. London, 1880, p. 441, October, 1880.

<sup>3</sup> Gill, T., Bul. U. S. Geol. & Geog. Surv. Terr., no. 2, series 2, pp. 91-120, 1875.

<sup>4</sup> Coues, E., Bul. U. S. Geol. & Geog. Surv. Terr., vol. 3, no. 3, pp. 631-653, May 15, 1877.

<sup>5</sup> Dobson, G. E., Monograph of the Insectivora, systematic and anatomical. Part 2, including the families Potamogalldæ, Chrysochloridæ, and Talpidæ, 1883.

<sup>6</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 19, pp. 1-112, 1896.

<sup>7</sup> True, F. W., loc. cit., p. 52.



- Condylura** Illiger, Prod. Syst. Mamm. et Avium, p. 125, 1811. Earliest available name for the genus of which the type is *Sorex cristatus* Linnæus. "We owe the name *Condylura* to the faulty figure of the animal given by De La Faille, in which the tail is represented as constricted at intervals, the whole resembling a string of beads. From this Illiger was led to include in his diagnosis the expression 'cauda mediocris nodosa,' and to bestow an inappropriate name."<sup>1</sup> Illiger includes two species under the genus: *Sorex cristatus* Linnæus and *Talpa longicaudata* Erxleben.
- Condylurus** Blainville, Ann. Français et Étrangères d'Anat. et de Physiol., vol. 2, p. 219, 1838. Emendation for *Condylura*, used subgenerically ad *Talpa cristata*.
- Condylus** Van Hyning, Science, n. s., vol. 38, p. 243, August 15, 1913. Misprint for *Condylura*.
- Condytura** Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 994, 1839. Used erroneously, but consistently, for *Condylura* Illiger.
- Neurotrichus** Rye, Zool. Record, vol. 17, index, p. 8, 1881. Emendation for *Neurotrichus* Günther.
- Neürotrichus** Günther, Proc. Zool. Soc. London, 1880, p. 441, October, 1880. Earliest name for the genus of which *Urotrichus gibbsii* Baird is the type. Sometimes used without the diæresis (*Neurotrichus* Forbes, Zool. Record, vol. 17, Mammalia, p. 14, 1881).
- Nëurotrichus** Günther, Proc. Zool. Soc. London, 1880, plate 42, October, 1880. Misprint for *Neürotrichus*.
- Parascalops** True, Proc. U. S. Nat. Mus., vol. 27, p. 242, April 26, 1894. The first available name for the genus of which *Scalops breweri* Bachman is the type.
- Perascalops** Beddard, Cambridge Nat. Hist., vol. 10, Mammalia, p. 518, 1902. Misprint for *Parascalops*.
- Rhinaster** Wagler, Nat. Syst. Amphib., p. 14, 1830. Name proposed by Wagler to replace *Condylura* Illiger which he considered misleading.<sup>2</sup> Under this he mentions two species: *Sorex cristatus* Linnæus and *Condylura prasinata* Harris.
- Scalops** Cuvier, Leçons d'Anatomie Comparée, vol. 1, Premier Tableau Général des Classes des Animaux, 1800. Nomen nudum. The generic name *Scalops* later was based upon *Sorex aquaticus* Linnæus by Illiger (Prod. Syst. Mamm. et Avium, p. 126, 1811), but is preoccupied by *Scalopus* Geoffroy.
- Scalopus** Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803. Earliest available name for the genus of which *Sorex aquaticus* Linnæus is the type.<sup>3</sup>
- Scalpos** Brooks, Rept. W. Va. State Board Agric., Quarter ending December 30, 1910, p. 28, 1911. Misprint for *Scalops*.
- Scapanus** Pomel, Archives Sci. Physiques et Nat., vol. 9, p. 247, November, 1848. Tenable name for the genus of which *Scalops townsendii* Bachman is the type.<sup>4</sup> Pomel's description<sup>5</sup> is faulty in that it states that the nostrils are lateral, a condition which is not found in *Scapanus townsendii*.

<sup>1</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 78, 1896.

<sup>2</sup> "Wie bekannt, ist der Schwanz dieses Thieres vollkommen eben." (Wagler, loc. cit.)

<sup>3</sup> Type fixed by Palmer, T. S. (Index Gen. Mamm., N. Am. Fauna No. 23, p. 621, 1904). The original generic description reads: "Caract. nat. Deux incisives à la mâchoire supérieure, quatre à l'inférieure, les intermédiaires fort petites; un boutoir, une queue assez longue; pieds pentadactyles, doigts des pâtes antérieures réunis jusqu'aux ongles seulement; ces ongles assez longs, plats, et dirigés un peu en arrière; corps couvert de poils." (Geoffroy, 1803, loc. cit.)

<sup>4</sup> Type fixed by Elliot, D. G. (Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 391, 1901).

<sup>5</sup> "2° type, LEPTORHINIENS, trompe grêle aiguë, narines ouvertes près de l'extrémité.

"Genres *Hyporyssus?*, *Scalops*, *Scapanus*."

"NOTA.—Ce troisième genre diffère des scalops par la position latérale et non supérieure de l'ouverture des narines, et par la formule dentaire comprenant une intermédiaire supérieure et trois inférieures de plus. Les espèces sont: *Scapanus Townsendii* (sic) et *Breweri* (Scal. *Townsendii* (sic) et *Breweri* Bachm.)." (Pomel, A., 1848, loc. cit., p. 247).

- Scapasius* Beddard, Cambridge Nat. Hist., vol. 10, Mammalia, p. 518, 1902. Misprint for *Scapanus*.
- Scaphanus* Herrick, Mamm. Minnesota, Geol. and Nat. Hist. Surv. Minnesota, Bul. 7, p. 55, 1892. Misprint or emendation for *Scapanus*.
- Sorex* Linnæus, Syst. Nat., ed. 10, vol. 1, p. 53, 1758. The American moles *Condylura cristata* and *Scalopus aquaticus* were placed in the genus *Sorex* by Linnæus. Shaw (Gen. Zool., Mamm., vol. 1, p. 531, 1800) described *Sorex radiatus* (= *Condylura cristata*) from a description and faulty figure by De La Faille.
- Talpa* Linnæus, Syst. Nat., ed. 10, vol. 1, p. 52, 1758. Type species: *Talpa europæa* Linnæus. A Palearctic genus with which some or all American moles were considered congeneric by certain early writers. Last used for American Talpidæ by Le Conte (Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 326, 1854), who referred to it the genera now known as *Scalopus*, *Scapanus*, and *Parascalops*.
- Talpasorex* Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. Substitution for *Condylura* Illiger.
- Talpasorex* Lesson, Manuel de Mammalogie, p. 124, 1827. Synonym of *Scalopus* Geoffroy. Based upon *Scalops pennsylvanica* Harlan (= *Sorex aquaticus* Linnæus), in the original description of which the dental formula was erroneously stated. Nec *Talpasorex* Schinz, by which it is preoccupied.
- Urotrichus* Temminck, Van der Hæven's Tijdschr. Nat. Geschied. Physiol., vol. 5, p. 286, 1838-1839. A Japanese genus with which *Neürotrichus* was included until 1880.

### Keys to the Genera of Moles.

[Based on external characters.]

- a*<sup>1</sup> Length of tail vertebræ less than one-fourth the total length; width of palm equaling or exceeding length of palm.
- b*<sup>1</sup> Tail naked or but scantily haired; nostrils superior.
- c*<sup>1</sup>. Tail somewhat slender, essentially naked; fore toes webbed; geographic range east of Rocky Mountains.....*Scalopus* (p. 27).
- c*<sup>2</sup>. Tail somewhat fleshy, scantily haired; fore toes not webbed; geographic range west of Rocky Mountains.....*Scapanus* (p. 54).
- b*<sup>2</sup> Tail densely covered with hair; nostrils lateral.....*Parascalops* (p. 77).
- a*<sup>2</sup> Length of tail vertebræ more than one-fourth the total length; width of palm less than length of palm.
- b*<sup>1</sup> Anterior end of snout surrounded by fringe of processes; nostrils circular to oval, anterior; geographic range east of Rocky Mountains...*Condylura* (p. 82).
- b*<sup>2</sup>. Anterior end of snout not surrounded by fringe of processes; nostrils crescentic, lateral; geographic range west of Rocky Mountains...*Neürotrichus* (p. 92).

[Based on cranial and dental characters.]

- a*<sup>1</sup>. Audital bullæ complete; interior basal projection of upper molars narrow, simple.
- b*<sup>1</sup>. Mastoids relatively heavy; interparietal small; no functional lower canine; lower incisors two; geographic range east of Rocky Mountains. *Scalopus* (p. 27).
- b*<sup>2</sup>. Mastoids relatively weak; interparietal large; lower canine present; lower incisors three; geographic range west of Rocky Mountains...*Scapanus* (p. 54).
- a*<sup>2</sup>. Audital bullæ incomplete; interior basal projection of upper molars relatively broad, lobed.
- b*<sup>1</sup>. Interior basal projection of first and second upper molars trilobed; premolars, 4.
- c*<sup>1</sup>. Braincase relatively broad and flat; anterior nares directed forward; first upper incisors broad, directed downward, with an exterior basal accessory cusp. ....*Parascalops* (p. 77).



- c<sup>2</sup>. Braincase relatively narrow and high; anterior nares directed obliquely upward; first upper incisors spatulate, directed somewhat forward, without a basal accessory cusp..... *Condylura* (p. 82).  
 b<sup>2</sup>. Interior basal projection of first and second upper molars bilobed; premolars,  $\frac{2}{2}$ ..... *Neirotichus* (p. 92).

**List of American Genera, Species, and Subspecies, with Type Localities.**

- Scalopus aquaticus aquaticus* (Linnæus)... Philadelphia, Pa. (p. 32).  
*aquaticus howelli* Jackson..... Autaugaville, Ala. (p. 36).  
*aquaticus australis* (Chapman)..... Gainesville, Fla. (p. 38).  
*aquaticus anastasæ* (Bangs)..... Point Romo, Anastasia Island, Fla. (p. 39).  
*aquaticus parvus* (Rhoads)..... Tarpon Springs, Fla. (p. 41).  
*aquaticus machrinus* (Rafinesque)..... Lexington, Ky. (p. 42).  
*aquaticus machrinoides* Jackson..... Manhattan, Kans. (p. 45).  
*aquaticus pulcher* Jackson..... Delight, Ark. (p. 46).  
*aquaticus caryi* Jackson..... Neligh, Nebr. (p. 48).  
*aquaticus intermedius* (Elliot)..... Alva, Okla. (p. 49).  
*aquaticus texanus* (Allen)..... Rockport, Tex. (p. 50).  
*æreus* (Bangs)..... Stilwell, Okla. (p. 52).  
*inflatus* Jackson..... 45 miles from Brownsville, Tex., in Tamaulipas, Mexico (p. 53).  
*Scapanus townsendii* (Bachman)..... Vicinity of Vancouver, Wash. (p. 58).  
*orarius orarius* True..... Shoalwater Bay, Wash. (p. 61).  
*orarius schefferi nobis*..... Walla Walla, Wash. (p. 63).  
*latimanus latimanus* (Bachman)..... Santa Clara, Cal. (p. 64).  
*latimanus occultus* Grinnell & Swarth. Santa Ana Canyon, Cal. (p. 68).  
*latimanus grinnelli* Jackson..... Independence, Cal. (p. 69).  
*latimanus sericatus* Jackson..... Yosemite, Cal. (p. 71).  
*latimanus minusculus* Bangs..... Fyffe, Cal. (p. 72).  
*latimanus dilatus* True..... Fort Klamath, Oreg. (p. 72).  
*latimanus alpinus* Merriam..... Crater Lake, Oreg. (p. 75).  
*anthonyi* Allen..... San Pedro Martir Mountains, Lower California. (p. 75).  
*Parascalops breweri* (Bachman)..... Marthas Vineyard, Mass. (p. 79).  
*Condylura cristata* (Linnæus)..... Eastern Pennsylvania (p. 86).  
*Neirotichus gibbsii gibbsii* (Baird)..... White River Pass, Wash. (p. 94).  
*gibbsii hyacinthinus* Bangs..... Nicasio, Cal. (p. 97).

**Genus SCALOPUS Geoffroy.**

- Scalops* Cuvier, Leçons d'Anat. Comp., tome 1, tabl. 1, 1800. (Nomen nudum.)  
*Scalopus* Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.  
*Scalops* Illiger, Prod. Syst. Mamm. et Avium, p. 126, 1811.  
*Talpasorex* Lesson, Manuel de Mamm., p. 124, 1827. Based upon *Scalops pennsylvanica* Harlan. Nec *Talpasorex* Schinz.  
*Scalpos* Brooks, Rept. W. Va. State Board Agric. for Quarter ending December 30 1910, p. 28, 1911.

*Type species*.—*Sorex aquaticus* Linnæus.

*Geographic range*.—Eastern and central Massachusetts, southeastern New York, southern Pennsylvania, extreme southern Ontario (Point Pelee), southern Michigan, northern Illinois, western

Wisconsin, central Minnesota, extreme southeastern South Dakota, northern Nebraska, extreme northeastern Colorado, south and east to northeastern Tamaulipas, Mexico (45 miles from Brownsville, Texas), to the Gulf of Mexico, and in Florida to Tampa Bay and Lemon City. (See fig. 2).

*External characters.*—Body robust, depressed; tail short, round, indistinctly annulated, very scantily haired (in appearance, essen-

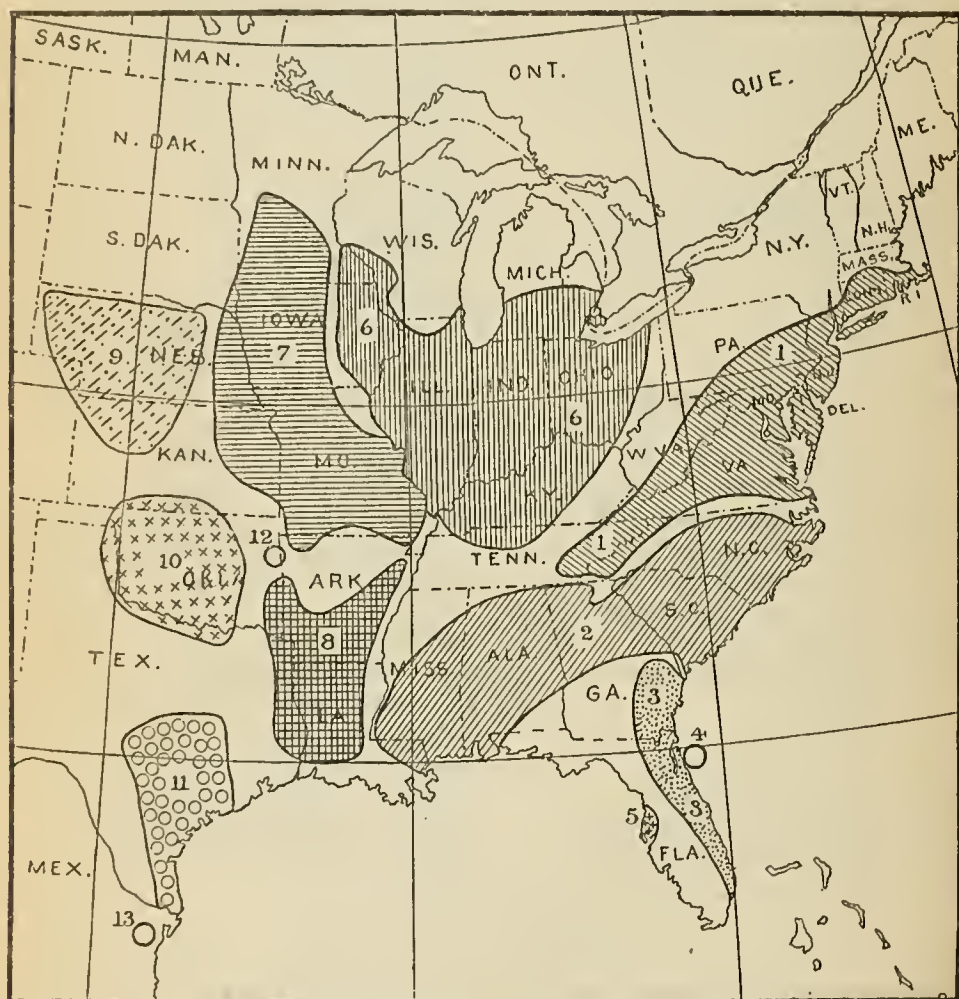


FIG. 2.—Geographic range of the species and subspecies of *Scalopus*.

B2008-103

- |                                    |                                |                                |
|------------------------------------|--------------------------------|--------------------------------|
| 1. <i>S. aquaticus aquaticus</i> . | 6. <i>S. a. machrinus</i> .    | 10. <i>S. a. intermedius</i> . |
| 2. <i>S. a. howelli</i> .          | 7. <i>S. a. machrinoides</i> . | 11. <i>S. a. texanus</i> .     |
| 3. <i>S. a. australis</i> .        | 8. <i>S. a. pulcher</i> .      | 12. <i>S. xerces</i> .         |
| 4. <i>S. a. anastasz</i> .         | 9. <i>S. a. caryi</i> .        | 13. <i>S. inflatus</i> .       |
| 5. <i>S. a. parvus</i> .           |                                |                                |

tially naked) (fig. 3). Head conoidal, depressed. Nose elongated into a distinct snout, apical portion naked to line of anterior edge of nasals; nostrils superior, crescentic, with concavities turned in laterally (fig. 4). Eyes minute, concealed in fur. Auricular orifice small. Legs short and stout. Feet large, fleshy, scantily haired above, naked below, without tubercles. Fore feet handlike, the palms



broader than long (fig. 5). Fore toes and hind toes webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and weak (fig. 6). Fur dense, soft, silky, the hairs nearly equal in length, producing a velvetlike pelage. Mammæ 6: latero-pectoral, 1-1; latero-abdominal, 1-1; inguinal, 1-1.



B2009-103  
FIG. 3.—Tail of *Scalopus aquaticus aquaticus* (X1½). No. 203190. U. S. Nat. Mus., Biological Survey collection; from Woodside, Montgomery County, Md.

Pelvis narrow, bones of the opposite sides adjunct under acetabula; two osseous bridges connect sacral vertebræ with ischium and produce four large foramina or openings, one in each of the angles formed by median lines of acetabula and sacral vertebræ. Superior surface of last sacral vertebra with a very small, low, laterally flattened, longitudinal process. Os falciforme long, reaching to proximal end of terminal phalange of first digit, wider and rather sharply incurved at base, narrower and gradually tapering distally.

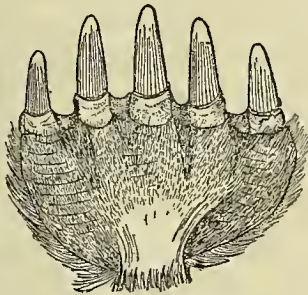
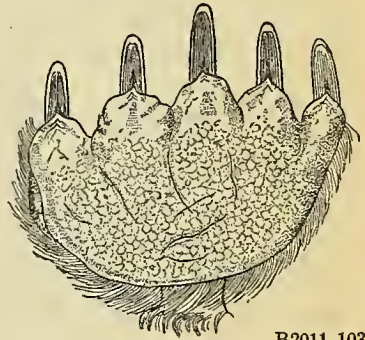


FIG. 5.—Fore foot of *S. a. aquaticus* (X1½). Individual referred to in fig. 2.



B2011-103

Skull conoidal, flat, with relatively broad braincase, and considerably constricted interorbitally. Mastoids relatively heavy and prominent. Interparietal short and narrow, somewhat irregular in outline, but usually narrower anteriorly. Frontal region flat, not much sloping; frontal sinuses swollen. Rostrum relatively short; anterior ends of premaxillæ much thickened and extending beyond nasals, forming an acute notch anterior to nasals. Anterior nares opening forward. Zygomata moderately long and heavy, not much curved, descending slightly and slanting inward anteriorly, the posterior end well back on squamosal. Foramen magnum oval, of moderate size. Infraorbital



B2012-103

FIG. 6.—Hind foot of *S. a. aquaticus* (X1½). Individual referred to in fig. 2.

foramen relatively small, the plate forming its outer wall moderately broad (slightly narrower than diameter of foramen). Audital bullæ complete, depressed (relatively higher than in *Scapanus*); auditory meatus short, scarcely developed. External pterygoid region much inflated posteriorly, slightly inflated anteriorly. Mesopterygoid space broad, the sides gently concave. Palate moderately elongate, terminating at a distance posterior to last molar about equal to diameter of that tooth; posterior border of palate truncate, frequently with a median notch or spine. Anterior palatine foramina small, oval to elliptical; first (anterior) pair of posterior palatine foramina small (smaller than anterior palatine foramina), round to oval; second (posterior) pair minute. Horizontal ramus of mandible heavy, curved upward both at posterior and anterior ends; coronoid process moderately elongate, triangular, somewhat acute, directed slightly posteriorly; angle of mandible relatively short, broad (broader than coronoid), and truncate; inferior mandibular notch moderate, subcircular, relatively narrow and deep.

*Dental characters.*—First upper incisor long and broad, convex in front, flat posteriorly; second and third upper incisors lateral, simple, conical, minute. Upper canine about two-thirds as large as first incisor, simple. Upper premolars indistinctly cuspidate, the second about twice the size of the first and about equal in size to canine (but broader), the third about half as large again as the second. Upper molars W-shaped in transverse section, with an antero-internal V-shaped cusplike shelf (not lobed); first and second molars subequal, the third much smaller.

First lower incisor small, elongate, conical; second lower incisor about twice the size of the first, elongate, caninelike, with an infero-internal longitudinal groove; no persistent lower canine. Premolars successively increasing in size posteriorly, somewhat simple, with a slight tendency toward the development of a cingulum posteriorly. Lower molars M-shaped in transverse section, the antero-internal cusp bilobed; molars successively decreasing in size posteriorly. Functional dentition: i.  $\frac{3}{2}$ ; c.  $\frac{1}{0}$ ; pm.  $\frac{3}{3}$ ; m.  $\frac{3}{3}$ ; total 36.<sup>1</sup>

### Keys to Species and Subspecies of *Scalopus*.

#### I. KEY TO ADULT MALES.

a.<sup>1</sup> Geographic range east of Mississippi River.

b.<sup>1</sup> Total length more than 153 mm.; greatest length of skull more than 33 mm.; breadth of skull across mastoids usually more than 17 mm.

c.<sup>1</sup> Total length less than 190 mm.; length of hind foot less than 21.5 mm.; greatest length of skull less than 37 mm.; breadth of skull across mastoids less than 19 mm ..... *Scalopus aquaticus aquaticus* (p. 32).

<sup>1</sup> The actual dentition of *Scalopus* is: i.  $\frac{4}{3}$ ; c.  $\frac{1}{1}$ ; pm.  $\frac{3}{3}$ ; m.  $\frac{3}{3}$ ; total, 40. The third lower incisor and the lower canine are nonpersistent and disappear before the animal is mature.



- c.<sup>2</sup> Total length more than 190 mm.; length of hind foot more than 21.5 mm.; greatest length of skull more than 37 mm.; breadth of skull across mastoids more than 19 mm. .... *Scalopus aquaticus machrinus* (p. 42).
- b.<sup>2</sup> Total length less than 153 mm.; greatest length of skull less than 33 mm.; breadth of skull across mastoids usually less than 17 mm.
- c.<sup>1</sup> Length of hind foot usually less than 17 mm.; greatest length of skull 31.2 mm. or less; breadth of skull across mastoids less than 16 mm.,  
*Scalopus aquaticus parvus* (p. 41).
- c.<sup>2</sup> Length of hind foot usually more than 17 mm.; greatest length of skull more than 31.2 mm.; breadth of skull across mastoids more than 16 mm.
- d.<sup>1</sup> Color golden sepia; face, chin, and wrists bright zinc orange; geographic range Anastasia Island, Fla. .... *Scalopus aquaticus anastasæ* (p. 39).
- d.<sup>2</sup> Color not golden sepia; face, chin, and wrists not bright zinc orange.
- e.<sup>1</sup> Color paler; greatest length of skull usually more than 32 mm.; geographic range North and South Carolina, northern and western Georgia, west to mouth of Mississippi River. .... *Scalopus aquaticus howelli* (p. 36).
- e.<sup>2</sup> Color darker; greatest length of skull usually less than 32 mm.; geographic range southeastern Georgia and eastern Florida,  
*Scalopus aquaticus australis* (p. 38).
- a.<sup>2</sup> Geographic range west of Mississippi River.
- b.<sup>1</sup> Breadth of skull across mastoids 19.3 mm. or more.
- c.<sup>1</sup> Breadth of skull across mastoids more than 20 mm.; palatilar length more than 16 mm. .... *Scalopus aquaticus machrinus* (p. 42).
- c.<sup>2</sup> Breadth of skull across mastoids less than 20 mm.; palatilar length less than 16 mm. .... *Scalopus aquaticus machrinoides* (p. 45).
- b.<sup>2</sup> Breadth of skull across mastoids less than 19.3 mm.
- c.<sup>1</sup> Greatest length of skull more than 33 mm.; interorbital constriction more than 7.3 mm.
- d.<sup>1</sup> Color coppery snuff brown. .... *Scalopus æreus* (p. 52).
- d.<sup>2</sup> Color not coppery snuff brown.
- e.<sup>1</sup> Color dark; geographic range east of 95th meridian,  
*Scalopus aquaticus pulcher* (p. 46).
- e.<sup>2</sup> Color pale; geographic range west of 95th meridian.
- f.<sup>1</sup> Nose and ankles tinged with ochraceous,  
*Scalopus aquaticus intermedius* (p. 49).
- f.<sup>2</sup> Nose and ankles not tinged with ochraceous, but usually with ivory yellow. .... *Scalopus aquaticus caryi* (p. 48).
- c.<sup>2</sup> Greatest length of skull less than 33 mm.; interorbital constriction less than 7.3 mm.
- d.<sup>1</sup> Prelachrymal region much inflated; rostrum broad and truncate; geographic range Tamaulipas, Mexico. .... *Scalopus inflatus* (p. 53).
- d.<sup>2</sup> Prelachrymal region not much inflated; rostrum not broad and truncate; geographic range Texas. .... *Scalopus aquaticus texanus* (p. 50).

## II. KEY TO ADULT FEMALES.

- a.<sup>1</sup> Geographic range east of Mississippi River.
- b.<sup>1</sup> Total length usually more than 148 mm.; greatest length of skull more than 32 mm.; breadth of skull across mastoids usually more than 16.5 mm.
- c.<sup>1</sup> Total length less than 173 mm.; length of hind foot less than 21 mm.; greatest length of skull less than 35.2 mm.; breadth of skull across mastoids less than 18.7 mm. .... *Scalopus aquaticus aquaticus* (p. 32).
- c.<sup>2</sup> Total length more than 173 mm.; length of hind foot more than 21 mm.; greatest length of skull more than 35.2 mm.; breadth of skull across mastoids more than 18.7 mm. .... *Scalopus aquaticus machrinus* (p. 42).



- b.<sup>2</sup> Total length usually less than 148 mm.; greatest length of skull 32 mm. or less; breadth of skull across mastoids usually less than 16.5 mm.
- c.<sup>1</sup> Total length less than 130 mm.; length of tail less than 18 mm.; greatest length of skull 29.3 mm. or less.....*Scalopus aquaticus parvus* (p. 41).
- c.<sup>2</sup> Total length more than 130 mm.; length of tail more than 18 mm.; greatest length of skull more than 29.3 mm.
- d.<sup>1</sup> Color golden sepia; face, chin, and wrists bright zinc orange; geographic range Anastasia Island, Fla.....*Scalopus aquaticus anastase* (p. 39).
- d.<sup>2</sup> Color not golden sepia; face, chin, and wrists not bright zinc orange.
- e.<sup>1</sup> Color paler; greatest length of skull usually more than 31 mm.; geographic range North and South Carolina, northern and western Georgia, west to mouth of Mississippi River.....*Scalopus aquaticus howelli* (p. 36).
- e.<sup>2</sup> Color darker; greatest length of skull usually less than 31 mm.; geographic range southeastern Georgia and eastern Florida,  
*Scalopus aquaticus australis* (p. 38).
- a.<sup>2</sup> Geographic range west of Mississippi River.
- b.<sup>1</sup> Total length more than 160 mm.; breadth of skull across mastoids more than 18.4 mm.
- c.<sup>1</sup> Breadth of skull across mastoids more than 19 mm.; palatilar length more than 15.8 mm.....*Scalopus aquaticus machrinus* (p. 42).
- c.<sup>2</sup> Breadth of skull across mastoids less than 19 mm.; palatilar length less than 15.8 mm.....*Scalopus aquaticus machrinoides* (p. 45).
- b.<sup>2</sup> Total length less than 160 mm.; breadth of skull across mastoids less than 18.4 mm.
- c.<sup>1</sup> Greatest length of skull more than 32 mm.; interorbital constriction more than 7.2 mm.
- d.<sup>1</sup> Color coppery snuff brown.....*Scalopus xreus* (p. 52).
- d.<sup>2</sup> Color not coppery snuff brown.
- e.<sup>1</sup> Color dark; geographic range east of 95th meridian,  
*Scalopus aquaticus pulcher* (p. 46).
- e.<sup>2</sup> Color pale; geographic range west of 95th meridian.
- f.<sup>1</sup> Nose and ankles tinged with ochraceous,  
*Scalopus aquaticus intermedius* (p. 49).
- f.<sup>2</sup> Nose and ankles not tinged with ochraceous, but usually with ivory yellow.....*Scalopus aquaticus caryi* (p. 48).
- c.<sup>2</sup> Greatest length of skull less than 32 mm.; interorbital constriction less than 7.2 mm.
- d.<sup>1</sup> Prelachrymal region much inflated; rostrum broad and truncate; geographic range Tamaulipas, Mexico.....*Scalopus inflatus* (p. 53).
- d.<sup>2</sup> Prelachrymal region not much inflated; rostrum not broad and truncate; geographic range Texas.....*Scalopus aquaticus texanus* (p. 50).

### Descriptions of Species and Subspecies of *Scalopus*.

#### SCALOPUS AQUATICUS AQUATICUS (Linnaeus).

##### EASTERN MOLE.

(Pl. I, figs. 1, 2; Pl. II, fig. 1; Pl. III, figs. 1, 1a; Pl. VI, fig. 3.)

*Sorex aquaticus* Linnaeus, Syst. Nat., ed. 10, p. 53, 1758.

*Talpa europæa flavescens* Erxleben, Syst. Reg. Anim., p. 118, 1777. Based on "yellow mole" of Pennant; typo locality, New York(?).

*Talpa Flava* Zimmermann, Specimen Zool. Geog., p. 496, 1777. Based on "yellow mole" of Pennant; typo locality, New York(?).

- Talpa fusca* Zimmermann, Specimen Zool. Geog., p. 497, 1777. Based on "Brown mole" of Pennant; type locality, New York(?).
- [*Talpa*] [*europæa*] *flava* Gmelin, Linn. Syst. Nat., ed 13, p. 110, 1788.
- Scalopus virginianus* Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 78, 1803. Type locality, Virginia(?).
- Talpa cupreata* Rafinesque, Précis des découv. et travaux somiologiques, p. 14, 1814. Type locality, "Atlantic States" (see Atl. Journ. 1832, p. 61).
- Scalops canadensis* Desmarest, Mammalogie, 1<sup>re</sup> partie, p. 155, 1820. New name for *Sorex aquaticus* Linnæus.
- Scalops pennsylvanica* Harlan, Fauna Amer., p. 33, 1825. Type locality unknown, probably Pennsylvania.
- Talpasorex pensylvanica* Lesson, Manuel de Mamm., p. 124, 1827.
- [*Scalops*] *aquaticus* Fischer, Synop. Mamm., p. 249, 1829.
- Talpa virginiana* Blainville (nec *Talpa virginiana* Brisson), Annales Franç. et Étrang. d'Anat. et de Physiol., tome 2, p. 219, 1838.
- Talpa sorex pensylvanicus* Blainville, Annales Franç. et Étrang. d'Anat. et de Physiol., tome 2, p. 219, 1838. (In synonymy.)
- Talpa* (*Scalops*) *Virginiana* Blainville (nec *Talpa virginiana* Brisson), Ostéographie, Atlas 1, table des planches, p. 4; Insectivores, pl. 5 (skull), pl. 9 (teeth), 1839-1864.
- T*[*alpa*] *aquatica* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.
- Scalops aquaticus aquaticus* True, Proc. U. S. Nat. Mus., vol. 7, 1884, p. 606, 1885.
- Scalopus aquaticus* Oberholser, Mammals and Summer Birds of Western North Carolina (publ. by Biltmore Forest School, Biltmore, N. C.), p. 3, June 30, 1905.
- Scalopus acquaticus* (sic) Hahn, Proc. U. S. Nat. Mus., vol. 32, p. 464, 1907.
- Scalpos* (sic) *aquaticus* Brooks, Rept. W. Va. Board Agric., 1910, p. 28, 1911.
- Scalopus aquaticus aquaticus* Miller, U. S. Nat. Mus., Bul. 79, p. 7, December 31, 1912.

*Type locality*.—Philadelphia, Pennsylvania.

*Geographic range*.—Eastern United States from eastern and southern Massachusetts, southeastern New York, and southeastern Pennsylvania, south through Virginia, and in the Appalachian Mountains south through western North Carolina and eastern Tennessee.

*General characters*.—Size medium; color dark; skull high, heavy, and angular; rostrum truncate; dentition moderate.

*Color*.—*Fresh winter pelage*: Back fuscous, fuscous-black, or blackish brown, becoming paler (drab-gray) on nose and ankles; fur at base of hairs dark neutral gray; underparts slightly paler than back, usually showing more neutral gray of base of hairs and frequently tinged ventrally with mummy brown or fuscous. *Summer pelage*: Slightly paler than in winter, usually more brownish; back sepia, fuscous, or fuscous-black; underparts paler than back, more grayish and usually tinged on chest with mummy brown or sepia. *Young*: More grayish than adults and seldom, if ever, tinged ventrally with brown.

*Skull*.—Medium in size, angular, much constricted interorbitally and usually somewhat depressed postorbitally, slightly swollen supraorbitally; mastoids moderately heavy; interparietal narrow;



coronoid process and angle of mandible broad and heavy, the former usually with a small mammiform process on posterior border; teeth medium.

*Measurements.*—Average of 2 adult males from type locality: Total length, 182.5 (180–185); tail vertebrae, 29.5 (28–31); hind foot, 21 (21–21). Average of 2 adult females from type locality: 154.5 (154–155); 23 (23–23); 19.5 (19–20). Average of 15 adult males from Washington, D. C.: 163.4 (154–175); 26.5 (22–29); 19.8 (18–21). Average of 8 adult females from Washington, D. C.: 152.6 (146–168); 26 (21–28); 19 (18–20). Average of 6 adult males from Wareham, Mass.: 159.8 (154–167); 26.3 (21.5–30); 19.9 (19.5–21). *Skull:* Average of 3 skulls of adult males from type locality: Greatest length, 35.3 (34.6–35.7); palatilar length, 14.8 (14.7–15); mastoidal breadth, 18 (17.8–18.2); interorbital breadth, 7.4 (7.3–7.5); maxillary tooth row, 10.9 (10.9–11); mandibular molar-premolar row, 10.7 (10.6–10.8). Average of 21 skulls of adult males from Washington, D. C., and vicinity: Greatest length, 34.3 (33.2–35.6); palatilar length, 14.7 (14.3–15.2); mastoidal breadth, 17.7 (17–18.3); interorbital breadth, 7.4 (7.2–7.8); maxillary tooth row, 10.8 (10.4–11.3); mandibular molar-premolar row, 10.4 (10.1–10.8). Average of 15 skulls of adult females from Washington, D. C., and vicinity: Greatest length, 32.9 (32.3–34.2); palatilar length, 13.9 (13.5–14.7); mastoidal breadth, 17.1 (16.3–17.5); interorbital breadth, 7.4 (7–7.6); maxillary tooth row, 10.4 (10.1–10.8); mandibular molar-premolar row, 10.2 (9.8–10.4). Average of 5 skulls of adult males from Wareham, Mass.: Greatest length, 34.3 (33.8–34.8); palatilar length, 14.8 (14.5–15); mastoidal breadth, 18.1 (17.8–18.4); interorbital breadth, 7.7 (7.6–7.7); maxillary tooth row, 11 (10.8–11.2); mandibular molar-premolar row, 10.7 (10.6–10.8). Average of 2 skulls of adult males from Dismal Swamp (Wallaceton), Va.: Greatest length, 35.2 (35.1–35.2); palatilar length, 14.8 (14.6–15); mastoidal breadth, 18.1 (18–18.2); interorbital breadth, 7.5 (7.4–7.6); maxillary tooth row, 11.1 (11–11.2); mandibular molar-premolar row, 10.7 (10.6–10.7). Skull of adult male from Roan Mountain, N. C.: Greatest length, 36.1; palatilar length, 15.5; mastoidal breadth, 18.4; interorbital breadth, 7.8; maxillary tooth row, 11.3; mandibular molar-premolar row, 11.

*Remarks.*—The first specific description of the common mole of eastern United States is that under *Sorex aquaticus* Linnæus;<sup>1</sup> Linnæus places in its synonymy "*Talpa, Virginianus, niger*" of Seba; but the description and figure<sup>2</sup> given by Seba seem to characterize the European rather than the American mole; the Linnæan description, however, clearly refers to the common mole of eastern America; as an

<sup>1</sup> Linnæus, Syst. Nat., ed. 10, p. 53, 1758.

<sup>2</sup> Seba, A., Thesaurus, vol. 1, p. 51, pl. 32, 1734. Seba's description of *Talpa virginianus niger* became the basis for Shaw's diagnosis of *Talpa purpurascens* (Shaw, G., Gen. Zool., Mamm., vol. 1, p. 521, 1800), which is therefore a synonym of *Talpa europæa* Linnæus.



authority for the habitat of the species, Linnæus cites Kalm, who saw mole runways along the Schuylkill River near Philadelphia.

In 1771 Pennant<sup>1</sup> described two abnormally colored or faded specimens of this species under the names of "Yellow Mole" and "Brown Mole"; the yellow mole became *Talpa europæa flavesceus* at the hands of Erxleben<sup>2</sup> in 1777, and the same year Zimmermann<sup>3</sup> named the yellow species *Talpa flava* and the brown one *Talpa fusca*. Geoffroy<sup>4</sup> described *Scalopus virginianus* in 1803, placing in synonymy under it *Talpa virginianus niger* Seba and *Sorex aquaticus* Linnæus.

The description given by Rafinesque<sup>5</sup> of *Talpa cupreata* is unsatisfactory, but seems to apply to the subspecies *S. a. aquaticus*. The synonymy of this form was still further encumbered when Desmarest<sup>6</sup> proposed the name *Scalops canadensis* in 1820, apparently basing the name upon "Le Scalope du Canada" of Cuvier and others. The last specific name added to the synonymy of this form is *Scalops pennsylvanica* Harlan;<sup>7</sup> Harlan believed the structure of the molars in the specimen he described to be different from that of *S. aquaticus*, but his description applies very accurately to *S. aquaticus* except as to the number of teeth, which he states to be forty; elsewhere, however, he writes that "this species corresponds in the number and arrangement of its teeth with the genus *Scalops* of F. Cuvier."<sup>8</sup>

*Scalopus aquaticus aquaticus*, the common mole of northeastern United States, in full winter pelage is the darkest of the genus. It is subject to slight local variations in size and color, and even in cranial characters, which, were they constant over any considerable geographic range, might be considered differential enough for subspecific recognition. Specimens from Marthas Vineyard and Nantucket Islands and from the mainland of southeastern Massachusetts average very slightly paler and smaller than typical *aquaticus*, and their skulls are slightly shorter and relatively broader than those from the type locality. Specimens from Liberty Hill, Conn., average large; eastern New York specimens are much like those from the vicinity of Philadelphia, Pa., while those from Long Island are very slightly smaller and possibly more grayish. Toward the south *aquaticus* gradually decreases in size, intergrading with *S. a. howelli* in northern and western North Carolina. A large series from the District of Columbia averages smaller than specimens from the type region, but in all essential characters except size they are

<sup>1</sup> Pennant, T., Quadrupeds, 1771. The writer has not had access to this publication, but presumes the descriptions are about the same as those in Pennant's History of Quadrupeds, ed. 3, vol. 2, pp. 230, 232, 1793.

<sup>2</sup> Erxleben, J. C. P., Syst. Reg. Anim., p. 118, 1777.

<sup>3</sup> Zimmermann, E. A. W., Spec. Zool. Geog., pp. 496-497, 1777.

<sup>4</sup> Geoffroy Saint Hilaire, É., Cat. Mamm. Mus. Nat. Hist. Nat., p. 78, 1803.

<sup>5</sup> Rafinesque, C. S., Précis des découv. et trav. somiolog., p. 14, 1814.

<sup>6</sup> Desmarest, A. G., Mammalogie, part 1, p. 155, 1820.

<sup>7</sup> Harlan, R., Fauna Amer., p. 33, 1825.

<sup>8</sup> Harlan, loc. cit., p. 34, 1825.

typical of *aquaticus*. Dismal Swamp, Va., produces a mole which is as large as the typical form and has a little more tendency toward a mummy brown shade on the back. Material from the Appalachian Mountain region is entirely too scarce to determine the exact relationship and area of intergradation of *aquaticus* with *S. a. machrinus*; a specimen from Roan Mountain, N. C., shows a very slight approach toward *machrinus* in size. A skin without skull from Walden Ridge, Tenn., is here rather arbitrarily referred to *aquaticus* on account of its size and color.

*Specimens examined*.—Total number, 322, as follows:

Connecticut: Cos Cob, 3; East Hartford, 2; Liberty Hill, 6.<sup>1</sup>

District of Columbia: Washington, 72.

Maryland: Anne Arundel County, 2; Baltimore, 2; Berwyn, 2; Branchville, 5; Cabin John, 1; Capitol View, 1; Chesapeake Beach, 1; Chevy Chase, 1; Highland, 1; Howard County, 1; Landover, 1; Laurel, 11; Mount Rainier, 1; Plummer's Island, 1; Rockville, 2; Seven Locks, 1; Silver Spring, 1; Woodside, 5.

Massachusetts: Holyoke, 1;<sup>1</sup> Middleboro, 1; Nantucket, 6;<sup>1</sup> Wareham, 32;<sup>1</sup> West Tisbury, 4.<sup>1</sup>

New Jersey: Afton, 1; Audubon, 6;<sup>2</sup> Englewood, 1;<sup>3</sup> Fairhaven, 1;<sup>1</sup> Haddonfield, 3.<sup>2</sup>

New York: Brooklyn, 1; Cold Spring Harbor, 1;<sup>3</sup> Cypress Hills, 1;<sup>3</sup> Dobb's Ferry, 1; Dunwoodie, 1;<sup>3</sup> Hastings, Westchester County, 6;<sup>3,4</sup> Lake Grove, 16; Locust Valley, 1;<sup>3</sup> Long Island, 1;<sup>4</sup> Mount Sinai, 2;<sup>3</sup> New Rochelle, 1;<sup>3</sup> New York City, 17;<sup>3,4</sup> Pelham Manor, 1;<sup>3</sup> Oyster Bay, 1; Piermont, 1;<sup>3</sup> Rye, 1;<sup>1</sup> Sing Sing, 15; Southampton, 1; Tarrytown Heights, 2.<sup>3</sup>

North Carolina: Asheville, 1;<sup>3</sup> Buncombe County, 2;<sup>1</sup> Highlands, 1; Magnetic City, 1; Roan Mountain (altitude 2500 feet), 1; Weaverville, 8.<sup>3,4</sup>

Pennsylvania: Carlisle, 6; Collingdale, 2;<sup>2</sup> Delaware County, 1; Marple, 1;<sup>2</sup> Mechanicsville, 1;<sup>2</sup> Media, 2;<sup>2</sup> Mifflintown, 1; Philadelphia (type locality), 6.<sup>2</sup>

Tennessee: Blount County, 1; Walden Ridge (near Soddy), 1.

Virginia: Alexandria County, 3; Arlington, 3; Bristow, 2; Clark County, 1; Dismal Swamp, 9; Eastville, 1; Falls Church, 9; Fort Myer, 6; Springvale, 1.

West Virginia: Berkeley Springs, 1.

## SCALOPUS AQUATICUS HOWELLI Jackson.

### HOWELL'S MOLE.

(Pl. I, fig. 3; Pl. II, fig. 2; Pl. III, figs. 2, 2a; Pl. VI, fig. 4.)

*Scalopus aquaticus howelli* Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

*Type locality*.—Autaugaville, Autauga County, Alabama.

*Type specimen*.—No. 177931, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected January 4, 1912, by L. S. Golsan.

*Geographic range*.—North Carolina (except in Appalachian Mountains), South Carolina, northern Georgia, thence southwest across

<sup>1</sup> Collection Mus. Comp. Zool., Harvard College.

<sup>2</sup> Collection Acad. Nat. Sci. Philadelphia.

<sup>3</sup> Collection Amer. Mus. Nat. Hist.

<sup>4</sup> Collection Field Mus. Nat. Hist.



central Alabama and southern Mississippi to Pensacola Bay and the Mississippi River.

*General characters*.—Intermediate in size between *S. a. aquaticus* and *S. a. australis*; usually paler than either *aquaticus* or *australis*; skull flat, less angular than in *aquaticus*; rostrum long and narrow.

*Color*.—*Full winter pelage*: Back dark drab, hair-brown, or fuscous, becoming in most specimens buffy brown on head; nose and wrists usually slightly suffused with ochraceous-tawny or cinnamon; underparts more grayish than back, usually much tinged with Saccardo's umber or tawny-olive. *Fresh summer pelage*: Back dark cinnamon-drab or drab, sometimes with a very slight coppery sheen, becoming cinnamon-buff or ochraceous-tawny on face; underparts hair-brown to neutral gray, grading into sepia on chest.

*Skull*.—Size medium (smaller than that of *S. a. aquaticus*, larger than that of *S. a. australis*) flat; rostrum long and narrow; mandible weak; coronoid process and angle of mandible weak and very narrow, incurved toward condyle, making superior and inferior notches small and relatively deep; teeth small.

*Measurements*.—Type (adult male): Total length, 152; tail vertebrae, 20; hind foot, 18. *Skull*: Average of 5 skulls of adult males from type locality: Greatest length, 32.3 (31.8–32.7); palatilar length, 13 (12.7–13.3); mastoidal breadth, 16.7 (16.3–17.1); inter-orbital breadth, 7.2 (7–7.4); maxillary tooth row, 10.1 (10–10.3); mandibular molar-premolar row, 10.1 (9.9–10.2).

*Remarks*.—Howell's mole differs from both *S. a. aquaticus* and *S. a. australis* in cranial characters and is not strictly intermediate between the two. It shows slight local variations which on account of scarcity of material are not fully understood. Skulls from Bay St. Louis and Washington, Miss., and from New Orleans and St. Tammany Parish, La., have braincases higher and narrower than typical specimens, and the rostra taper more gradually; none of the skulls, however, is from a fully adult animal, and it is possible that age might change this condition. Skulls from Biloxi, Cedarbluff, and Kemper County, Miss., are slightly heavier and more angular than those from the type region. In northern North Carolina *S. a. howelli* begins to approach *aquaticus* in size. A series of specimens from Young Harris, Ga., shows in color a tendency toward *aquaticus* and has skulls which in angularity and height of braincase are like those of *aquaticus*, but which in size and breadth of rostrum are like those of *howelli*. A skin without skull from Pensacola, Fla., is indeterminable, but is provisionally referred to *howelli*.

*Specimens examined*.—Total number, 106, as follows:

**Alabama**: Ardell, 1; Auburn, 1; Autaugaville (type locality), 15; Castleberry, 2; Cottondale, 1; Eutaw, 1; Greensboro, 3; Huntsville, 1; Sand Mountain (near Carpenter), 3.



Florida: Pensacola, 1.<sup>1</sup>

Georgia: Columbus, 2; Crawfordsville, 1; Griffin, 1; Young Harris, 12.

Louisiana: New Orleans, 2; St. Francisville, 1; St. Tammany Parish, 1.<sup>2</sup>

Mississippi: Bay St. Louis, 3; Biloxi, 2; Cedarbluff, 1; Kemper County, 1; Washington, 1.

North Carolina: Apex, 1;<sup>3</sup> Bertie County, 1;<sup>1</sup> Jackson, 2; Kinston, 3; Moran, Chowan County, 1; Raleigh, 23; Wilkesboro, 1.

South Carolina: Abbeville, 1;<sup>4</sup> Beaufort County, 4; Calhoun Falls, 1;<sup>3</sup> Catawba, 2;<sup>3</sup> Charleston, 1; Frogmore, 4; Georgetown, 1; Oakley, 2; Society Hill, 1.

### SCALOPUS AQUATICUS AUSTRALIS (Chapman).

#### FLORIDA MOLE.

(Pl. II, fig. 3; Pl. III, figs. 3, 3a; Pl. VI, fig. 5.)

*Scalops aquaticus australis* Chapman, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 339, December 22, 1893.

*Scalopus aquaticus australis* Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 470, 1905.

*Type locality*.—Gainesville, Alachua County, Florida.

*Type specimen*.—No.  $\frac{3916}{2290}$ , Amer. Mus. Nat. Hist.; young adult, sex unknown, skin and skull; collected May 4, 1891, by F. M. Chapman.

*Geographic range*.—Southeastern Georgia and the eastern portion of peninsular Florida south to Lemon City.

*General characters*.—Size small (smaller than *howelli*); feet relatively large; tail relatively short; skull short and broad (relatively broader and higher than that of *howelli*); teeth small.

*Color*.—*Full winter pelage*: Back clove brown, mummy brown, or dark fuscous, paler on wrists, slightly tinged with ochraceous-buff on nose; underparts similar to back but showing more dark neutral gray at base of hairs. *Worn winter pelage*: Variable; back clove brown or mummy brown to vinaceous-buff, drab, or drab-gray with or without pinkish buff or ochraceous-buff on nose; beneath much as above, more grayish.

*Skull*.—Small, not angular, less constricted interorbitally than in *S. a. aquaticus*, and not much depressed postorbitally; mastoids not heavy; coronoid process and angle of mandible narrow and weak, the former generally without mammiform process on posterior border; horizontal ramus of mandible weak; teeth small.

*Measurements*.—Average of 6 adult males from type locality: Total length, 145 (141–150); tail vertebrae, 24.9 (22–28); hind foot, 18 (17–19). Average of 10 adult females from type locality: 138.8 (131–148); 22.6 (21–26); 17.3 (16–18). *Skull*: Average of 6 skulls of adult males from type locality: Greatest length, 31.7 (31.3–32); palatilar length, 12.9 (12.4–13.3); mastoidal breadth, 16.6 (16–16.8); interorbital

<sup>1</sup> Collection Mus. Comp. Zool., Harvard College.

<sup>2</sup> Collection Amer. Mus. Nat. Hist.

<sup>3</sup> Collection Field Mus. Nat. Hist.

<sup>4</sup> Collection Univ. Michigan Mus.

breadth, 7.2 (7.1–7.3); maxillary tooth row, 9.9 (9.6–10.3); mandibular molar-premolar row, 9.6 (9.4–9.8). Average of 11 skulls of adult females from type locality: Greatest length, 30.4 (29.5–30.8); palatilar length, 12.4 (12–12.7); mastoidal breadth, 16.1 (15.6–16.4); interorbital breadth, 7 (6.7–7.3); maxillary tooth row, 9.6 (9.4–9.7); mandibular molar-premolar row, 9.4 (9.2–9.6).

*Remarks.*—The small size of *S. a. australis*, together with its relatively short, broad, and high skull, readily distinguish it from *S. a. howelli*, its nearest relative toward the north. Its characters are retained very constantly throughout most of its geographic range. Skulls of specimens from St. Catherines Island, Ga., are actually and relatively longer than those of typical *australis*, and in this respect approach *howelli*; in other characters the skulls do not differ essentially from those of typical *australis*; in color these specimens are inseparable from *australis*. A similar though less marked tendency toward *howelli* is noticeable in specimens from Ossabaw Island and Barrington, Ga. South of the type locality *australis* decreases slightly in size; specimens from Oak Lodge and Lemon City, Fla., are of minimum size and average very slightly smaller and darker than those from the type region.

*Specimens examined.*—Total number, 115, as follows:

**Florida:** Canaveral, 1; East Micco, 2;<sup>1</sup> Enterprise, 6;<sup>1,2</sup> Eustis, 1; Gainesville (type locality), 25; Georgiana, 1; Indian River, 1; Jacksonville, 3; Lake Harney, 3; Lake Worth, 1; Lemon City, 1; Lynne, 5; New Berlin, 6;<sup>2,3</sup> Micanopy, 2; Oak Lodge (East Peninsula opposite Micco), 21;<sup>3</sup> Orange Hammock, Kissimmee River, 1; Saint Augustine, 1; Saint Charles Creek, 1;<sup>2</sup> West Jupiter, 1.<sup>2</sup>

**Georgia:** Barrington, 2;<sup>3</sup> Cumberland Island, 2;<sup>3</sup> Hursmans Lake, 10;<sup>3</sup> Montgomery, 3;<sup>3</sup> Nashville, 1; Ossabaw Island, 4;<sup>3</sup> Pinetucky, 3;<sup>3</sup> Saint Catherines Island, 5;<sup>3</sup> Saint Simons Island, 1; Sterling, 1.<sup>3</sup>

## SCALOPUS AQUATICUS ANASTASÆ (Bangs).

### ANASTASIA ISLAND MOLE.

(Pl. II, fig. 4.)

*Scalops anastasæ* Bangs, Proc. Boston Soc. Nat. Hist., vol. 28, p. 212, 1898.

*Scalops anastasiæ* (sic) Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 391, 1901.

*Scalopus anastasæ* Cory, Field Mus. Nat. Hist., publ. 153, zool. series, vol. 11, p. 438, June, 1912.

*Type locality.*—Point Romo, Anastasia Island, Florida.

*Type specimen.*—No. 7192, Mus. Comp. Zool., Harvard College, Bangs collection; ♂ adult, skin and skull; collected February 16, 1897, by Outram Bangs.

*Geographic range.*—Anastasia Island, Fla.

<sup>1</sup> Collection Amer. Mus. Nat. Hist. <sup>2</sup> Collection Field Mus. Nat. Hist. <sup>3</sup> Collection Mus. Comp. Zool.

*General characters.*—Size of *S. a. australis*: Fore foot relatively large, nails long and heavy; skull short, massive; mastoids, heavy; rostrum short.

*Color.*—*Late winter pelage*: Back golden sepia; face, chin, and wrists bright zinc orange; underparts Sudan brown. *Worn winter pelage*: Paler than in late winter pelage with less golden and zinc orange, and showing more light neutral gray of base of hairs.

*Skull.*—Small, short, and heavy, narrow through mastoids; mastoids heavy; rostrum short; mandible heavy; coronoid process and angle of mandible short; ascending ramus wide; superior notch shallow.

*Measurements.*—Average of 2 adult males from type locality: Total length, 137.5 (134–141); tail vertebrae, 21.8 (21–22.5); hind foot, 17.8 (17.5–18). *Skull*: Average of 2 skulls of adult males from type locality: Greatest length, 31.5 (31.4–31.6); palatilar length, 12.8 (12.6–12.9); mastoidal breadth, 16.5 (16.4–16.6); interorbital breadth, 7.1 (7–7.1); maxillary tooth row, 10 (9.9–10); mandibular molar-premolar row, 9.7 (9.6–9.8).

*Remarks.*—Four of the eight moles examined from Anastasia Island are topotypes in the Bangs collection and were collected by Outram Bangs, February 12–16, 1895; the other four are in the Field Museum and were collected by Thaddeus Surber at Espanita, Anastasia Island, January 25–29, 1901. The two series are very unlike. The specimens collected at Espanita have no orange or golden suffusions and can not be separated by skin characters from *S. a. australis* of the mainland; the skulls, however, are shorter than those of typical *australis* and have shorter rostra and slightly heavier mastoids, and in these characters are more like those of *S. a. anastase*. In a letter, in regard to these specimens, dated August 19, 1913, Surber states:

"Espanita" was the home of a Mr. Middleton (a Georgian) located well toward the southern end of the island about 15 miles south of St. Augustine, on the Matanzas River side of island. Most of my work was done in the vicinity of his house, near which I was camped. \* \* \* In the flesh I could never detect any difference between these island moles and those from the mainland. \* \* \* There were no towns nor villages on the island during my visit in 1901, so that I was forced to use this designation (Espanita) for the locality. Mr. Bangs's specimens came from the lower end of the island, I believe, but two or three miles from where these were secured.

Bangs, in a letter to the writer October 23, 1913, referring to the locality where Surber collected, states:

I am quite sure \* \* \* that that part of the island is quite different from where I was. He got *Peromyscus floridanus* where he was. In the parts of the island I worked I never saw it at all though I trapped hundreds of small mammals. In fact, there was no country suitable to it. Where I caught my moles they were not common. They were in the salt flats and low sandy stretches, where their long tunnels extended about in the white sand and through the flats. There was very little vegetation here except, of course, "sea oats."



All the specimens from Anastasia Island are here provisionally called *anastasæ*, although additional material may result in some change of decision. Were the specimens from Espanita older individuals, their skulls might be inseparable from those from Point Romo. The topotype series was taken about two weeks later in the year than that from Espanita. Two weeks is a short time for changes in the pelage, yet such changes are apparently rapid in *Scalopus*, and it would not be entirely impossible for the full winter pelage of the mole at Espanita to develop before molting into a pelage similar to that of the topotype series.

*Specimens examined*.—Total number, 8, as follows:

**Florida:** Espanita, Anastasia Island, 4;<sup>1</sup> Point Romo (type locality), Anastasia Island, 4.<sup>2</sup>

SCALOPUS AQUATICUS PARVUS (Rhoads).

LITTLE MOLE.

(Pl. II, fig. 5; Pl. III, figs. 4, 4a.)

*Scalops parvus* Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1894, p. 157, 1894.

[*Scalops*] [*aquaticus*] *parvus* Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

*Type locality*.—Tarpon Springs, Hillsboro County, Florida.

*Type specimen*.—No. 8468, Acad. Nat. Sci. Philadelphia (No. 1468, Rhoads collection); ♀ adult, skin and skull; collected December 24, 1893, by W. S. Dickinson.

*Geographic range*.—Region north of Tampa Bay, in Hillsboro and Pasco Counties, Fla.

*General characters*.—Smallest of the genus; tail relatively short, shorter than that of *S. a. australis*; color much like *australis*; skull small, weak; rostrum very narrow (narrower than that of *australis*).

*Color*.—*Full winter pelage*: Much like corresponding pelage of *S. a. australis*; back sepia or dark sepia, becoming pinkish cinnamon or ochraceous-buff on nose; underparts slightly paler than back and showing dark neutral gray of base of hairs, sometimes tinged with cinnamon-brown.

*Skull*.—Like that of *S. a. australis* but smaller, weaker, and with rostrum actually and relatively narrower; teeth small.

*Measurements*.—Average of 3 adult males from Port Tampa City, Fla.: Total length, 134.3 (131–136); tail vertebræ, 19.7 (19–20.5); hind foot, 16.8 (16.5–17). *Skull*: Average of 3 skulls of adult males from Port Tampa City, Fla.: Greatest length, 30.6 (30.2–31.2); palatilar length, 12.7 (12.5–12.9); mastoidal breadth, 15.7 (15.5–15.8); interorbital breadth, 7.1 (7.1–7.3); maxillary tooth tow, 9.8

<sup>1</sup> Collection Field Mus. Nat. Hist.

<sup>2</sup> Collection Mus. Comp. Zool, Harvard College.

(9.6-10); mandibular molar-premolar row, 9.7 (9.5-10). Skull of type (probably a female, though sexed "male" by collector): Greatest length, 29.3; palatilar length, 11.9; mastoidal breadth, 15.1; inter-orbital breadth, 6.6; maxillary tooth row, 9.2; mandibular molar-premolar row, 9.2.

*Remarks.*—The original description of this form was based upon a single specimen which was unique in collections for several years. True,<sup>1</sup> on account of insufficient material, placed *parvus* in questionable synonymy under *S. a. australis*, where it has since remained. The number of specimens now available from the type region is far from satisfactory, but they show characters sufficient to warrant their separation from *australis*. The type of *S. a. parvus* is in worn pelage; True<sup>2</sup> was inclined to believe on account of the appearance of the skin and the peculiarly worn state of the teeth that the mole had been kept in confinement; there appears no reason for such a conclusion, however, the wear in the teeth and pelage of the type being nothing which might not occur in the normal habitat of the mole. Three males from Port Tampa City, Fla., while distinctly different from *australis*, do not appear to be the extreme type of *parvus*; unfortunately, however, the only specimens from the immediate vicinity of the type locality, except the type, are young.

*Specimens examined.*—Total number, 9, as follows:

Florida: Belleair, 2; Port Richey, 1;<sup>3</sup> Seven Oaks, 1; <sup>4</sup> Port Tampa City, 3;<sup>5</sup> Tarpon Springs (type locality), 2.<sup>3</sup>

#### SCALOPUS AQUATICUS MACHRINUS (Rafinesque).

##### PRAIRIE MOLE.

(Pl. II, fig. 6; Pl. VI, fig. 6.)

*Talpa machrina* Rafinesque, Atlantic Journ., vol. 1, p. 61, 1832.

*Talpa sericea* Rafinesque, Atlantic Journ., vol. 1, p. 61, 1832. Type locality near Nicholasville and Harrodsburg, Ky.

*Scalops argentatus* Audubon & Bachman, Journ. Acad. Nat. Sci. Philadelphia, vol. 8, p. 292, 1842. Type locality southern Michigan.

*Talpa Pennantii* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854. Type locality unknown.

*Scalops aquaticus argentatus* Coues, Bul. U. S. Geol. & Geog. Surv. Terr., vol. 3, p. 633, 1877.

*Scalops (aquaticus var.) argentatus* Herrick, Mamm. of Minnesota, Geol. & Nat. Hist. Surv. Minnesota. Bul. 7, p. 54, 1892.

*Scalops aquaticus machrinus* True, Proc. U. S. Nat. Mus., vol. 19, p. 20, December 21, 1896.

*Scalopus aquaticus machrinus* Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 470, 1905.

<sup>1</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 21, 1896.

<sup>4</sup> Collection of Hartley H. T. Jackson.

<sup>2</sup> True, loc. cit., p. 34, 1896.

<sup>5</sup> Collection Mus. Comp. Zool. Harvard College.

<sup>3</sup> Collection Acad. Nat. Sci. Philadelphia.

*Type locality*.—Lexington, Fayette County, Kentucky.

*Type specimen*.—None known to exist.

*Geographic range*.—Eastern Iowa, and east of the Mississippi River west of the Appalachian Mountains from western Wisconsin, northern Illinois, southern Michigan, southwestern Ontario (Point Pelee), and northern Ohio, south to central Tennessee.

*General characters*.—Largest of the genus; tail relatively long; color paler than that of *S. a. aquaticus* and usually more reddish brown; skull flat, broad, heavy, and angular; rostrum massive; teeth very large.

*Color*.—*Full winter pelage*: Above, sepia, mummy brown, or hair-brown, occasionally showing pinkish buff or cinnamon-buff on nose; underparts more grayish than back and usually tinged with Prout's brown or cinnamon-brown. *Summer pelage*: Slightly paler than winter pelage and usually more grayish.

*Skull*.—Large, broad, angular, and massive; mastoids very massive; rostrum large; coronoid process and angle of mandible heavy, the former frequently with a distinct secondary process on posterior margin; dentition very heavy.

*Measurements*.—Adult male from type locality: Total length, 208; tail vertebrae, 38; hind foot, 24. Adult male from Midway, Ky.: 190; 29; 22.5. Adult female from Midway, Ky., 175; 27; 22. Average of 3 adult males from Warsaw, Ill., 199 (194–206), 35.7 (31–38).

*Skull*: Adult male from Midway, Ky.: Greatest length, 39.1; palatilar length, 16.7; mastoidal breadth, 20.7; interorbital breadth, 8.2; maxillary tooth row, 12.2; mandibular molar-premolar row, 11.6. Skull of adult female from Midway, Ky.: Greatest length, 37.7; palatilar length, 16.2; mastoidal breadth, 19.2; interorbital breadth, 7.7; maxillary tooth row, 12.1; mandibular molar-premolar row, 11.7. Average of 5 skulls of adult males from Warsaw, Ill.: Greatest length, 39.2 (38.8–39.5); palatilar length, 16.8 (16.6–17); mastoidal breadth, 20.5 (20.3–20.7); interorbital breadth, 7.9 (7.7–8.1); maxillary tooth row, 12.4 (11.9–12.6); mandibular molar-premolar row, 12 (11.5–12.2).

*Remarks*.—The name *Talpa machrina* Rafinesque<sup>1</sup> and the earliest description of this form were apparently lost to science from shortly after they were published until True<sup>2</sup> resurrected them in 1896; Rafinesque very accurately describes the form and distinctly indicates "near Lexington" as the locality where the species occurred. In the same publication Rafinesque describes another mole, "found in woods near Nicholasville and Harrodsburg," under the name *Talpa sericea*;<sup>3</sup> his second species is clearly the young of his *Talpa machrina*. Audubon and Bachman<sup>4</sup> described a mole from southern Michigan,

<sup>1</sup> Rafinesque, C. S., *Atlantic Journ.*, vol. 1, p. 61, 1832.

<sup>2</sup> True, F. W., *Proc. U. S. Nat. Mus.*, vol. 19, p. 20, 1896.

<sup>3</sup> Rafinesque, *loc. cit.*, p. 62, 1832.

<sup>4</sup> Audubon and Bachman, *Jour. Acad. Nat. Sci. Philadelphia*, vol. 8, p. 292, 1842.



in 1842, under the name *Scalopus argentatus*; although Michigan specimens of *Scalopus* average slightly smaller than typical *S. a. machrinus*, and possibly also slightly paler, the difference is insufficient for subspecific recognition. Le Conte<sup>1</sup> in 1854 described a mole under the name of *Talpa pennantii* which he seemed to believe was the yellow mole of Pennant; Pennant's yellow mole, however, received Latin binomial designation as early as 1777<sup>2</sup> and is purely a synonym of *S. a. aquaticus*. Le Conte states in his description of *T. pennantii* that it "differs from *S. aquaticus* in being much larger (equal in size to *Talpa europæa*) and in having much larger anterior feet."<sup>3</sup> It is evident, therefore, that the specimen he had in hand was probably *S. a. machrinus*.

This large mole retains its characters with remarkable regularity throughout its range. Specimens from the Mississippi Basin in western Wisconsin, as far north as Prescott, Pierce County, are as large as specimens from the type region, if not slightly larger; specimens from eastern Iowa are indistinguishable from specimens from Kentucky. The color tends to become more grayish in northern and western Illinois and in western Wisconsin, possibly indicating an approach toward *S. a. machrinoides*. Moles from Big Sandy and Nashville, Tenn., have somewhat weaker dentition than typical *machrinus* but do not differ essentially in other respects.

*Specimens examined*.—Total number, 159, as follows:

**Illinois:** Alton, 2; Belleville, 1; Calhoun, 3;<sup>4</sup> Chicago, 9;<sup>5</sup> Fremont, 1; Hamilton, 1; Joliet, 1;<sup>6</sup> Olive Branch, 1;<sup>5</sup> Olney, 5; Ozark, 1;<sup>5</sup> Parkersburg, 2; Ravenswood, 1;<sup>6</sup> Richland County, 7; Riehl Station, 1; Rosiclare, 1;<sup>5</sup> "Southern Illinois," 3; Union County, 2; Warsaw, 18.

**Indiana:** Denver, 2;<sup>4</sup> Effner, Newton County, 1; Fort Wayne, 1; Lake Maxinkuckee, 3; Madison, 1; New Lebanon, 1; Waterloo, 2; West Baden, 2;<sup>6</sup> Wheatland, 2.

**Iowa:** Hillsboro, 1; Knoxville, 1.<sup>5</sup>

**Kentucky:** Eubanks, 1; Lexington (type locality), 1; Midway, 3.

**Michigan:** Ann Arbor, 2;<sup>4</sup> Chelsea, 1;<sup>4</sup> Denton, 2;<sup>4</sup> Flushing, 3;<sup>7</sup> Greenfield, 1;<sup>8</sup> Holland, 1;<sup>5</sup> Lansing, 1;<sup>4</sup> Manchester, 1; Milan, 1;<sup>4</sup> Portage Lake, 11;<sup>4</sup> Saline, 1.

**Ohio:** Cleveland, 1; Fairfield County, 1; Madisonville, 3; Salem, 1.

**Ontario:** Point Pelee, 25.<sup>8, 9</sup>

**Tennessee:** Big Sandy, 1; Clarksville, 1; Nashville, 3;<sup>6</sup> Tennessee River, 1.

**Wisconsin:** Camp Douglas, 2; Durand, 1; Fountain City, 4;<sup>6</sup> Maiden Rock, 3;<sup>6</sup> Prescott, 1;<sup>6</sup> Wyalusing, 4.<sup>6</sup>

<sup>1</sup> Le Conte, Joseph, Proc. Acad. Nat. Sci., Philadelphia, vol. 6, 1853, p. 327, 1854.

<sup>2</sup> *Talpa europæa flavescens* Erxleben (Syst. Reg. Anlm., p. 118) and *Talpa flava* Zimmermann (Spec. Zool. Geog. p. 497).

<sup>3</sup> Le Conte, loc. cit.

<sup>4</sup> Collection Univ. Michigan Mus.

<sup>5</sup> Collection Field Mus. Nat. Hist.

<sup>6</sup> Collection Milwaukee Public Mus.

<sup>7</sup> Collection of Hartley H. T. Jackson.

<sup>8</sup> Collection Victoria Mem. Mus.

<sup>9</sup> Collection of W. E. Saunders, London, Ontario.

## SCALOPUS AQUATICUS MACHRINOIDES Jackson.

MISSOURI VALLEY MOLE.

(Pl. II, fig. 7.)

*Scalopus aquaticus machrinoides* Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

*Type locality*.—Manhattan, Riley County, Kansas.

*Type specimen*.—No. 169717, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected June 1, 1910, by W. E. Berg.

*Geographic range*.—West of the Mississippi River, except eastern Iowa, from central Minnesota, southeastern South Dakota, and the eastern border of Nebraska, south through northeastern Kansas to extreme northern Arkansas.

*General characters*.—Size large, exceeded only by *S. a. machrinus*; color more grayish than *machrinus*; skull heavy, angular, smaller than that of *machrinus*, with a shorter rostrum, and relatively smaller inferior mandibular notch.

*Color*.—*Winter pelage*: Upperparts ranging from bistre to clove brown, becoming paler on face and wrists; underparts slightly paler than back, and usually showing more slate color of base of hairs, washed ventrally with raw umber or mummy brown. *Summer pelage*: Upperparts light drab, drab, or wood brown, paler on face, nose, and ankles; beneath slightly paler than back, more grayish.

*Skull*.—Most nearly like that of *S. a. machrinus*, but smaller, with a relatively shorter rostrum; ascending ramus of mandible not so heavy as in *machrinus*, and inferior mandibular notch smaller; rostrum short and broad; molariform dentition very heavy.

*Measurements*.—Average of 3 adult males from Elk River, Minn.: Total length, 172 (168–178); tail vertebræ, 30 (27–32); hind foot, 22.2 (22–22.5). Average of 3 adult females from Fort Leavenworth, Kans., Bismarck, Mo., and Council Bluffs, Iowa: 181 (180–182); 32 (31–33); 22.3 (22–23). *Skull*: Average of 3 skulls of adult males from type locality: Greatest length, 37.1 (36.2–37.7); palatilar length, 15.3 (15.2–15.5); mastoidal breadth, 19.4 (19.3–19.5); interorbital breadth, 8. (7.9–8.1); maxillary tooth row, 12 (11.8–12.1); mandibular molar-premolar row, 11.8 (11.5–12).

*Remarks*.—The Mississippi River separates the range of *S. a. machrinus* from that of *S. a. machrinoides* except for a short distance where the former extends into Iowa. Specimens from St. Louis, Mo., are somewhat intermediate between the two forms, being larger than typical *machrinoides* and having relatively longer rostra. Toward the north (Elk River, Minn.), *machrinoides* decreases slightly in size; along the western border of its range it intergrades with *S. a. caryi*,

specimens from Lincoln, Nebr., being smaller and paler than typical *machrinoides*, while those from Vermilion, S. Dak., though large, are distinctly paler than the typical form and have higher, more rounded skulls. Two specimens from Carthage, Mo., and one from Winslow, Ark., are smaller than specimens from the type region, and have smaller teeth and narrower rostra; the heavy mastoids and the massive skulls are much as in *machrinoides*. A series from Greenway, Ark., shows a very slight approach toward *S. a. pulcher* in color and width of rostrum, but is easily referable to *machrinoides*.

*Specimens examined*.—Total number, 77, as follows:

Arkansas: Greenway, 7;<sup>1</sup> Winslow, 1.

Iowa: Council Bluffs, 1.

Kansas: Burlington, 1; Fort Leavenworth, 4; Manhattan (type locality), 6; Neosho Falls, 2; Onaga, 2; Stillwater Creek, 1.

Minnesota: Elk River, 4; Fort Snelling, 2.

Missouri: Bismarck, 1; Carthage, 2;<sup>2</sup> Charleston, 1; Columbia, 11; Independence, 1; Marble Hill, 1; St. Louis, 7; Stotesbury, 9.<sup>3</sup>

Nebraska: Everett, 1; Fort Crook, 2;<sup>4</sup> Lancaster County, 1;<sup>5</sup> Lincoln, 5;<sup>5</sup> Perch, 1.<sup>4</sup>

South Dakota: Big Sioux River (at mouth), 1; Vermillion, 2.<sup>6</sup>

#### SCALOPUS AQUATICUS PULCHER Jackson.

##### ARKANSAS MOLE.

(Pl. II, fig. 8.)

*Scalopus aquaticus pulcher* Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

*Type locality*.—Delight, Pike County, Arkansas.

*Type specimen*.—No. 170698, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected January 20, 1911, by W. G. Savage.

*Geographic range*.—Humid lowland region of southern and eastern Arkansas, southeastern Oklahoma, northwestern and central Louisiana, and eastern Texas.

*General characters*.—About the size of *S. a. aquaticus*; hind foot larger; skull larger than that of *aquaticus*, flatter, less swollen supra-orbitally, wider interorbitally; interparietal wider than in *aquaticus*; skull narrower through mastoids than that of *S. a. machrinoides*, with narrower rostrum and smaller teeth. Slightly larger than *Scalopus xreus*; skull relatively wider interorbitally, through mastoids and through rostrum, flatter and more angular.

*Color*.—*Full winter pelage*: Back dark fuscous with many hairs tipped with pearl gray, producing in places a slightly frosted appearance; top of head mummy brown; nose cinnamon-brown; underparts

<sup>1</sup> Collection Field Mus. Nat. Hist.

<sup>2</sup> Collection of Hartley H. T. Jackson.

<sup>3</sup> Collection Mus. Comp. Zool., Harvard College.

<sup>4</sup> Collection Amer. Mus. Nat. Hist.

<sup>5</sup> Collection Univ. Nebraska.

<sup>6</sup> Collection Univ. South Dakota.



sepia, showing much blackish plumbeous of base of hairs. *Worn winter pelage*: Above fuscous or olive-brown, usually tinged on head with mummy brown or Saccardo's umber; underparts dark neutral gray, becoming paler anteriorly, tinged with bister. *Fresh summer pelage*: Upperparts olive-brown shading into coppery seal brown on head and face; nose and wrists slightly tinged with ochraceous-orange; beneath, bright cinnamon, becoming grayish posteriorly.

*Skull*.—Somewhat similar to that of *S. a. aquaticus*, but slightly larger, less angular, with flatter braincase, and averaging wider inter-orbitally and through mastoids; postorbital region less depressed than in *aquaticus*, zygomata heavier posteriorly, and horizontal ramus of mandible more arched ventrally; no distinct secondary process on posterior margin of coronoid process, though central portion of posterior border of ascending ramus is sometimes slightly expanded posteriorly.

*Measurements*.—Average of 6 adult males from type locality: Total length, 155.9 (153–170); tail vertebræ, 25 (23–29); hind foot, 22 (21–23). Average of 3 adult females from type locality: 149.3 (146–156); 23.3 (20–25); 21 (20–22). *Skull*: Average of 7 skulls of adult males from type locality: Greatest length, 35.6 (34.7–37.4); palatilar length, 14.7 (14.2–15.4); mastoidal breadth, 18.2 (17.6–19.2); interorbital breadth, 7.8 (7.5–8.2); maxillary tooth row, 11.3 (11–11.7); mandibular molar-premolar row, 11 (10.8–11.5). Average of 3 skulls of adult females from type locality: Greatest length, 34.3 (34.1–34.6); palatilar length, 14.3 (14.2–14.4); mastoidal breadth, 18 (17.5–18.3); interorbital breadth, 7.7 (7.4–8); maxillary tooth row, 10.9 (10.7–11); mandibular molar-premolar row, 10.7 (10.6–10.8).

*Remarks*.—Like other members of the genus, this beautiful mole is subject to slight local variations throughout its range. Specimens from Grand Coteau and Clarks, La., are somewhat smaller than the typical form; one from Clarks is unusually grayish for the form, but the much-worn fur and the partial molt may account for the color. The very few not immature in a series from Mer Rouge, La., are much alike in color, but are not so richly colored as most specimens of *S. a. pulcher*; skulls of males, however, show the greatest individual variation observed in any series from a single locality; two skulls are indistinguishable from topotype skulls of *pulcher*; two others are long, narrow, high, and rotund, and have narrow rostra; another is short, broad, and flat, and has a broad rostrum; age may possibly account for some of the variation, and incorrect sex determinations may also be partly responsible. An old male from Lake City, Ark., is in some respects intermediate between *pulcher* and *S. a. machrinoides*; the teeth are large; the mastoids almost as heavy as those

of *machrinoides*; and the rostrum is slightly heavier than that of typical *pulcher*, but in size and other characters it is very similar to skulls from the type locality. The specimen is in very fresh spring pelage, a little of the winter fur remaining on nose and rump, and in color it seems to be more nearly like *machrinoides* than *pulcher*. A specimen from Fort Smith, Ark., and one from Wister, Okla., neither adult, are referable to *pulcher*.

*Specimens examined*.—Total number, 67, as follows:

Arkansas: Camden, 1; Delight (type locality), 15; Lake City, 1; Fort Smith, 1; Wilmot, 1.

Louisiana: Clarks, 1; Columbia, 1; <sup>1</sup> Grand Coteau, 1; Mer Rouge, 23; Natchitoches, 1; Shreveport, 3.

Oklahoma: Wister, 1. <sup>2</sup>

Texas: Joaquin, 1; Sour Lake, 16.

### SCALOPUS AQUATICUS CARYI Jackson.

#### NORTHERN PLAINS MOLE.

(Pl. II, fig. 9.)

*Scalopus aquaticus caryi* Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 20, February 2, 1914.

*Type locality*.—Neligh, Antelope County, Nebraska.

*Type specimen*.—No. 116799, U. S. Nat. Mus., Biological Survey collection; ♂ young adult, skin and skull; collected September 18, 1901, by Merritt Cary.

*Geographic range*.—Arid and semiarid plains region of central and western Nebraska, northeastern Colorado, and northwestern Kansas.

*General characters*.—Size medium; tail long; color palest of the genus; most nearly like *S. a. intermedius* but much paler and lacking ochraceous suffusions on nose and wrists; skull slightly shorter than that of *intermedius* and relatively broader interorbitally.

*Color*.—*Autumn pelage*: Back light drab slightly tending toward avellaneous, becoming paler on head and shading in some cases into ivory yellow on nose; underparts much the same color as back, more mixed with neutral gray and occasionally washed with Saccardo's umber or cinnamon-brown.

*Skull*.—Size moderate, short, broad, and rotund; rostrum short; mandible heavy; dentition relatively heavy. Very similar to the skull of *S. a. intermedius* but slightly shorter and relatively broader interorbitally. Compared with the skull of *S. a. pulcher* that of *S. a. caryi* is shorter and higher, wider interorbitally, and has weaker mastoids, shorter, wider rostrum, and larger teeth; it is larger, much higher, and more massive than the skull of *S. æreus*, and is much smaller, higher, and less angular than that of *S. a. machrinoides*,

<sup>1</sup> Collection Field Mus. Nat. Hist.

<sup>2</sup> Collection Carnegie Mus.

though in extreme old age it tends to become angular and the brain-case flattens.

*Measurements*.—Average of 3 males from type locality: Total length, 159 (157–160); tail vertebræ, 32 (31.5–32.5); hind foot, 21.1 (20.3–22). *Skull*: Average of 3 skulls of males from type locality: Greatest length, 34.2 (33.1–34.8); palatilar length, 14.2 (14.1–14.4); mastoidal breadth, 17.8 (17–18.4); interorbital breadth, 8.1 (7.7–8.4); maxillary tooth row, 11.2 (11.1–11.3); mandibular molar-premolar row, 10.9 (10.8–11).

*Remarks*.—This subspecies can be distinguished from all other moles by its pale color and lack of ochraceous suffusions. Its nearest relationships are with *intermedius* with which it probably intergrades in southern Kansas.

*Specimens examined*.—Total number 16, as follows:

Colorado: Wray, 1.

Kansas: Long Island, 3.<sup>1</sup>

Nebraska: Kennedy, 1; Neligh (type locality), 4; Long Pine, 2;<sup>2</sup> Niobrara River, 1;<sup>3</sup> "Sandhills," 1; Warbonnet Canyon, Sioux County, 3.<sup>3</sup>

### SCALOPUS AQUATICUS INTERMEDIUS (Elliot).

#### SOUTHERN PLAINS MOLE.

*Scalops machrinus intermedius* Elliot, Field Columb. Mus., publ. 37, zool. series, vol. 1, p. 280, 1899.

[*Scalops*] [*aquaticus*] *intermedius* Elliot, Field Columb. Mus. publ. 45, zool. series, vol. 2, p. 390, 1901.

*Scalopus aquaticus intermedius* Bailey, N. Am. Fauna No. 25, p. 207, October 24, 1905.

*Type locality*.—Alva, Woods County, Oklahoma.

*Type specimen*.—No. 6832, Field Mus. Nat. Hist.; ♂ adult, skin and skull; collected February 23, 1899, by Thaddeus Surber.<sup>4</sup>

*Geographic range*.—Central and western Oklahoma and adjacent parts of northern Texas.

*General characters*.—Size medium; tail relatively long; color pale with ochraceous on nose and wrists, darker and more ochraceous than *caryi*; skull relatively short, high and heavy, but not angular; rostrum short; teeth large.

*Color*.—*Winter pelage*: Back light drab to drab tinged with buff-pink; nose and wrists ochraceous-buff to zinc orange; underparts

<sup>1</sup> Collection Amer. Mus. Nat. Hist.

<sup>2</sup> Collection Stanford Univ.

<sup>3</sup> Collection Univ. Nebraska.

<sup>4</sup> Mr. C. B. Cory, in a letter dated March 20, 1914, advises the writer that the specimen labeled as the type of *Scalops machrinus intermedius* Elliot is No. 6829, Field Mus. Nat. Hist., collected at Alva, Okla., December 8, 1899, by Thaddeus Surber. In the original description Elliot designates no type specimen by number, but describes an adult male collected at Alva, Okla., February 23, 1899, by Thaddeus Surber. Since No. 6832, Field Mus. Nat. Hist. is the only specimen of the original series to which this description can apply, it is necessary to consider it the type of *intermedius*.



slightly paler than back, more silvery and showing less buff-pink; base of hairs deep neutral gray. *Young*: More plumbeous than adults, darker, less pink-buff tinge on back and little or no ochraceous-buff on nose and wrists.

*Skull*.—Resembles that of *S. a. caryi* in nearly every particular, but averages slightly larger, is usually slightly more depressed post-orbitally, and has relatively heavier molariform dentition.

*Measurements*.—Average of 4 adult males from type locality: Total length, 164.5 (160–169); tail vertebræ, 28.8 (27–31); hind foot, 21.8 (21–22). *Skull*: Average of 4 skulls of adult males from type locality: Greatest length, 35 (34.5–35.6); palatilar length, 14.7 (14.5–14.9); mastoidal breadth, 18.3 (17.8–18.5); interorbital breadth, 8.1 (7.8–8.3); maxillary tooth row, 11.4 (10.9–11.7); mandibular molar-premolar row, 11.1 (10.5–11.4).

*Remarks*.—The subspecies *intermedius* can be distinguished from its nearest congener, *S. a. caryi*, by its slightly darker color, and, in full adult pelage, by the ochraceous-buff or zinc orange on nose and wrists; the skull of *intermedius* is generally longer than that of *caryi*. Specimens from Mount Scott, Okla., are a little darker than typical *intermedius*, and the skulls are slightly longer. Intergradation between this subspecies and *S. a. texanus* apparently occurs in north-central Texas. It seems probable that *intermedius* intergrades also with *S. a. pulcher* in eastern Oklahoma, though specimens from Red Fork, Okla., show no approach to *pulcher*. An alcoholic specimen from Belknap, Tex., too young for positive identification, is provisionally referred to *intermedius*.

*Specimens examined*.—Total number, 22, as follows:

Oklahoma: Alva (type locality), 6; Dougherty, 1;<sup>1</sup> Fort Reno, 1; Mount Scott, 5; Red Fork, 3.

Texas: Belknap, 1; Lipscomb, 3; Mobeetie, 2.

#### SCALOPUS AQUATICUS TEXANUS (Allen).

##### TEXAS MOLE.

(Pl. II, fig. 10; Pl. III, figs. 5, 5a; Pl. VI, fig. 7.)

*Scalops argentatus texanus* Allen, Bul. Amer. Mus. Nat. Hist., vol. 3, p. 221, April 29, 1891.

*Scalops texanus* Allen, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, 1893.

*Scalops aquaticus texanus* True, Proc. U. S. Nat. Mus., vol. 19, p. 21, 1896.

[*Scalops*] [*aquaticus*] *texensis* (sic) Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

*Scalopus aquaticus texanus* Bailey, N. Am. Fauna No. 25, p. 206, October 24, 1905.

*Scalopus aquaticus texensis* (sic) Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 471, 1905.

<sup>1</sup> Collection Field Mus. Nat. Hist.

*Type locality*.—Rockport, Aransas County, Texas.

*Type specimen*.—No.  $\frac{3488}{2740}$ , Amer. Mus. Nat. Hist.; sex unknown; skin and skull; collected September, 1887, by William Lloyd.

*Geographic range*.—Coast region of Texas from Matagorda Bay to Cameron County, north in the interior to central and east-central Texas.

*General characters*.—Size small; much smaller, darker, and more brownish than *intermedius*; back generally much tinged with bronze, and nose and wrists suffused with orange; skull small, flat, much depressed postorbitally, and swollen supraorbitally; rostrum short; teeth large.

*Color*.—*Full winter pelage*: Back Saccardo's umber to mummy brown with bronze tinge; nose and wrists zinc orange to xanthine orange; underparts much like back, less bronze, occasionally tinged with amber-brown; base of hairs dark mouse gray dorsally, becoming slightly paler ventrally. *Fresh summer pelage*: Slightly paler than winter pelage, less brown, with less orange on nose and wrists; underparts distinctly more grayish than in winter pelage.

*Skull*.—Small, flat, constricted interorbitally, much depressed postorbitally, and swollen supraorbitally; rostrum short; mandible relatively heavy; teeth relatively large. The skull of *S. a. texanus* is very much smaller than that of *S. a. intermedius* or *S. a. pulcher*; about the size of that of *S. a. australis* but differs from it in shape and in having much heavier mandibles and dentition.

*Measurements*.—Average of 8 adult males from type locality: Total length, 138.5 (128–152); tail vertebræ, 23.8 (21–26); hind foot, 17.2 (15.5–18). Average of 4 adult females from type locality: 133.8 (130–137); 22.3 (20–24); 16.3 (15–17). *Skull*: Average of 9 skulls of adult males from type locality: Greatest length, 31 (30–32); palatilar length, 13 (12.7–13.7); mastoidal breadth, 16.6 (16.1–17); interorbital breadth, 6.8 (6.6–7.1); maxillary tooth row, 10.3 (10–10.6); mandibular molar-premolar row, 10.1 (9.7–10.3). Average of 4 skulls of adult females from type locality: Greatest length, 29.8 (29.3–30.2); palatilar length, 12.6 (12.3–12.8); mastoidal breadth, 16.2 (15.9–16.5); interorbital breadth, 6.9 (6.7–7.1); maxillary tooth row, 9.8 (9.7–9.9); mandibular molar-premolar row, 9.7 (9.5–9.9).

*Remarks*.—Local variation in the genus seems to reach its maximum in *S. a. texanus*, there being no two localities from which specimens of this form have been examined but exhibit differences either in skin or cranial characters, or in both; there is, however, very little individual variation in a series from any one locality. Unfortunately, no considerable number of specimens are available except from Rockport, Tex., and until extensive series of specimens and careful habitat

studies are obtained from each of many localities it will be impossible to determine the extent and meaning of these variations. The large series from the type locality is remarkably uniform in characters except for seasonal color variations. Skulls from Corpus Christi are slightly larger, higher through the braincase, and broader through the rostrum than typical *texanus*, as are also two believed to have been collected at Brownsville, Tex.; specimens from Padre Island are very slightly longer than those from Rockport; one from Santa Rosa is high and weak and has a rather short rostrum. The color of the Santa Rosa specimen is much paler than that of typical *texanus* due probably to the peculiar condition of the pelage. Specimens from Mason have large skulls and pale color and in these respects seem to approach *S. a. intermedius*; the skulls, however, are flat and have narrow rostra. A skin without skull from Waco is inclined toward *intermedius* in color, but is much too small for that form and has been provisionally called *texanus*; another skin, in very soiled pelage, from Longpoint, Tex., does not differ from typical *texanus* in size or color.

*Specimens examined*.—Total number, 42, as follows:

**Texas:** Brownsville, 2; Corpus Christi, 2; Longpoint, 1; Mason, 3; Padre Island, 3; Rockport (type locality), 25; San Antonio, 4; Santa Rosa, 1; Waco, 1.<sup>1</sup>

#### SCALOPUS ÆREUS (Bangs).

##### COPPERY MOLE.

(Pl. II, fig. 12; Pl. III, figs. 7, 7a; Pl. VI, fig. 9.)

*Scalops texanus æreus* Bangs, Proc. Biol. Soc. Washington, vol. 10, p. 138, December 28, 1896.

[*Scalops*] *æreus* Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

*Scalops aquaticus æreus* Miller & Rehn, Proc. Boston Soc. Nat. Hist., vol. 30, p. 250, December, 1901.

*Scalopus æreus* Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 471, 1905.

*Scalopus aquaticus æreus* Miller, U. S. Nat. Mus., Bul. 79, p. 8, December 31, 1912.

*Type locality*.—Stilwell, Payne County, Oklahoma.

*Type specimen*.—No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ adult, skin and skull; collected August 13, 1896, by Thaddeus Surber.

*Geographic range*.—Known only from type locality.

*General characters*.—Size medium; differs from all other forms of *Scalopus* in its color, a rich coppery snuff brown; skull weak and narrow.

*Color*.—Type (female), in *late summer pelage*: Upperparts rich coppery snuff brown; underparts less coppery than above, more grayish.

<sup>1</sup> Collection Acad. Nat. Sci. Philadelphia.



*Skull*.—Much smaller, weaker, and narrower than that of *S. a. machrinoides*, *S. a. pulcher*, or *S. a. intermedius*; larger than that of *S. a. texanus*, relatively longer, less depressed postorbitally and less swollen supraorbitally, with longer, narrower rostrum; teeth small.

*Measurements*.—Type (adult female): Total length, 154; tail vertebræ, 24; hind foot, 19. *Skull* (of type): Greatest length, 33.2; palatilar length, 14; mastoidal breadth, 17; interorbital breadth, 7.5; maxillary tooth row, 10.6; mandibular molar-premolar row, 10.5.

*Remarks*.—The status and relationships of this form are unknown. The type and only specimen in collections was taken August 13, 1896; the rich coppery color may be due in part to a deadening of the summer fur preceding molt and if such proves to be the case the coppery color will not be of diagnostic value. The skull is weak, narrow, moderately high and rounded, and has a long, narrow rostrum; the teeth are much worn, the sutures closed, and from all appearances the animal was adult; it was sexed female by the collector.

*Specimen examined*.—One, the type.

#### SCALOPUS INFLATUS Jackson.

##### TAMAULIPAS MOLE.

(Pl. II, fig. 11; Pl. III, figs. 6, 6a; Pl. VI, fig. 8.)

*Scalopus inflatus* Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 21, February 2, 1914.

*Type locality*.—State of Tamaulipas, Mexico (45 miles from Brownsville, Texas).

*Type specimen*.—No. 52709, U. S. Nat. Mus., Biological Survey collection; young adult, sex unknown; skin and imperfect skull; collected in 1892 by F. B. Armstrong.

*Geographic range*.—Known only from type locality.

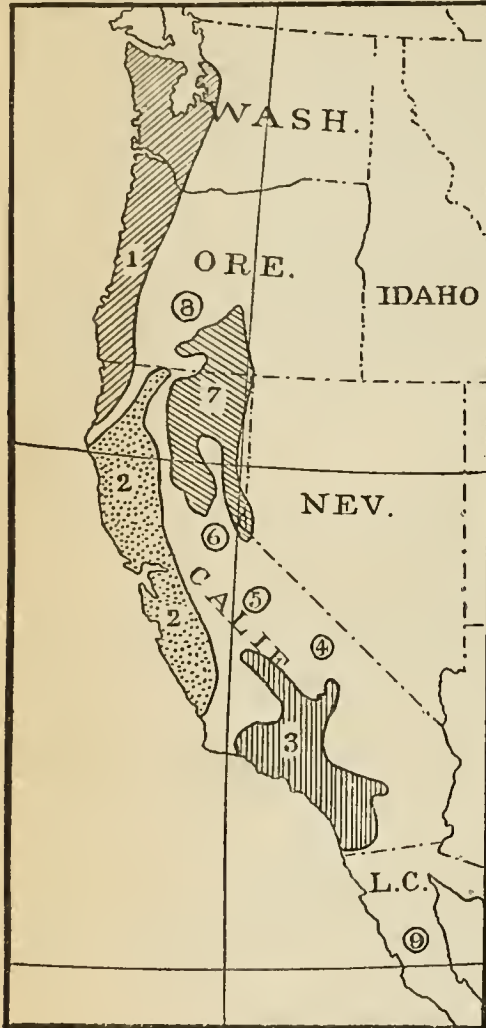
*General characters*.—Size small, larger than *S. a. texanus*; skull broad, high, and arched, much inflated in prelachrymal region; rostrum broad, truncate; zygomata heavy.

*Color*.—Back between wood brown and drab, becoming ochraceous-buff on cheeks; general tone of underparts much as on back but more mixed with mouse gray.

*Skull*.—Size medium, high and arched; prelachrymal region much swollen; audital bullæ high and well defined; zygomata heavy; posterior edge of lachrymal foramen meets zygoma at nearly right angle; rostrum broad; mandible heavy, horizontal ramus much arched ventrally; outer groove in third upper premolar pronounced; first lower premolar small and inconspicuous.

*Measurements*.—Type (from dry skin, foot relaxed): Tail vertebræ, 18; hind foot, 16.5. *Skull* (of type): Palatilar length, 13.4; mastoidal breadth, 17; interorbital breadth, 7.1; maxillary tooth row, 11.1; mandibular molar-premolar row, 11.

*Remarks.*—The only-known specimen of this form is imperfect; it lacks complete data, the pelage is ragged and apparently faded, and the posterior portion of the braincase is broken away. Aside from its many other distinctive characters, *Scalopus inflatus* can easily be separated from all other members of the genus by the peculiarly



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FIG. 7.—Geographic range of the species and subspecies of *Scapanus* except *S. orarius* (see fig. 12).

- |                                    |                              |
|------------------------------------|------------------------------|
| 1. <i>S. townsendii</i> .          | 6. <i>S. l. minusculus</i> . |
| 2. <i>S. latimanus latimanus</i> . | 7. <i>S. l. dilutus</i> .    |
| 3. <i>S. l. occultus</i> .         | 8. <i>S. l. alpinus</i> .    |
| 4. <i>S. l. grinnelli</i> .        | 9. <i>S. anthonyi</i> .      |
| 5. <i>S. l. sericatus</i> .        |                              |

California (except the southeastern desert region), south to San Pedro Martir Mountains, Lower California (figs. 7 and 12).

*External characters.*—Body robust, depressed; tail short, round, thick and fleshy, tapering apically and slightly constricted proximally, indistinctly annulated, scantily haired with coarse hairs

inflated prelachrymal region of the skull. It was at first thought that this inflation was due to parasites; but the bilateral symmetry of the inflations, the fact that no apparent work of parasites has been noticed in this region of the skull in the many hundred specimens of *Scalopus* examined, and, further, the fact that a very slight and inconspicuous tendency toward prelachrymal inflation is present in all members of the genus, leads to the belief that the inflation in this species is an extreme accentuation of normal development.

*Specimen examined.*—One, the type.

#### Genus *SCAPANUS* Pomel.

*Scapanus* Pomel, Archives Sci. Physiques et Nat., tome 9, p. 247, November, 1848.

*Scaphanus* Herrick, Geol. and Nat. Hist. Surv., Minnesota, Bul. 7, p. 55, 1892.

*Scapasius* Beddard, Cambridge Nat. Hist., vol. 10, p. 518, 1902.

*Type species.*—*Scalops townsendii* Bachman.

*Geographic range.*—Southwestern British Columbia (Fraser River region), western and southern Washington, western Oregon, extreme western Nevada,



(fig. 8). Head conoidal, depressed. Nose elongated into a snout (shorter and less truncate than in *Scalopus*), the apical portion naked to line of anterior edge of nasals; nostrils superior, crescentic, with concavities turned in laterally (fig. 9). Eyes minute, concealed in fur. Auricular orifice small. Legs short and stout. Feet large, fleshy, scantily haired above, naked below. Fore feet handlike, the palms as broad as long (fig. 10). Soles of hind feet with one to three (usually two) distinct tubercles. Fore toes and hind toes not webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and weak (fig. 11). Fur dense, soft, silky, the hairs nearly equal in length, producing a velvetlike pelage. Mammæ, 8: latero-pectoral, 2-2; latero-abdominal, 1-1; inguinal, 1-1.

*Skeletal characters.*—Clavicle short and heavy, about three-fourths as broad as long, distinctly notched on the inferior border, not penetrated by a foramen. Humerus heavy, about three-fourths as broad as long. Pelvis narrow, bones of opposite sides scarcely touching under acetabula; two osseous bridges, each bifurcate posteriorly, connect sacral vertebræ with ischium and produce six foramina or openings, a large one in each of the anterior angles formed by median lines of acetabula and sacral vertebræ and two smaller ones in each of the posterior angles. Superior surface of last sacral vertebra without longitudinal process. Os falciforme relatively broad and long, reaching proximal end of terminal phalange of first digit, gently incurved, not much tapering distally.

Skull conoidal, flat, with relatively broad braincase, and slightly constricted interorbitally. Mastoids moderately heavy, not prominent. Interparietal large, somewhat rectangular, breadth (anteroposterior diameter) about one-third the length, slightly convex anteriorly and concave posteriorly with a posterior median projection. Frontal region flat, not much sloping; frontal sinuses somewhat

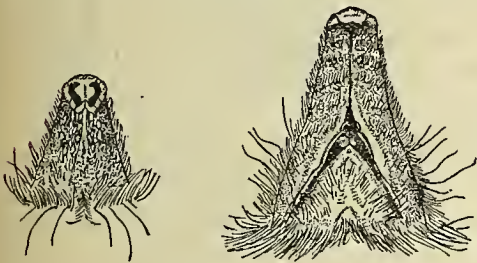


FIG. 9.—Snout of *S. l. latimanus* ( $\times 1\frac{1}{2}$ ). Individual referred to in fig. 8.



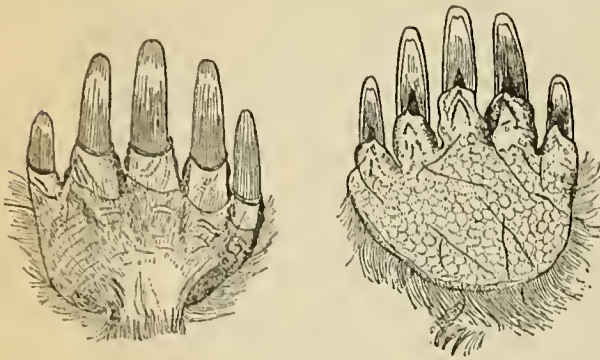
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FIG. 8.—Tail of *Scapanus latimanus latimanus* ( $\times 1\frac{1}{2}$ ). No. 105258, U. S. Nat. Mus.; from Colma, San Mateo County, Cal.

swollen. Rostrum moderately long; anterior ends of premaxillæ slightly thickened and extending beyond nasals, forming a notch (acute to truncate) anterior to nasals. Anterior nares opening forward. Zygomatics moderately long and heavy; rather sharply curved inward anteriorly, the posterior end attached about medially on squamosal. Foramen magnum oval, of moderate size. Infraorbital



foramen relatively small (larger than in *Scalopus*), the plate forming its outer wall moderately broad. Audital bullæ complete, depressed; auditory meatus short (more developed than in *Scalopus*). External pterygoid region moderately inflated both posteriorly and anteriorly. Mesopterygoid space moderately broad and relatively long, the sides nearly straight and slightly converging posteriorly. Palate moderately elongate, termin-



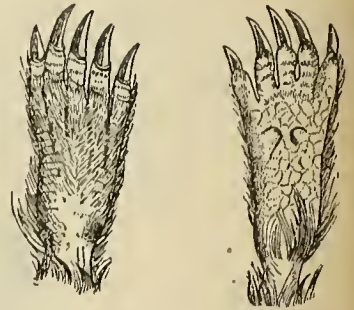
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FIG. 10.—Fore foot of *S. l. latimanus* (X 1½). Individual referred to in fig. 8.

ating at a distance posterior to the last molar about equal to half the diameter of that tooth; posterior border of palate truncate or slightly emarginate, usually with a slight median notch. Anterior palatine foramina moderate, oval to elliptical-oval; posterior palatine foramina small (the first pair larger than the second), round to oval. Horizontal ramus of mandible moderately heavy, somewhat curved upward at posterior end, nearly straight at anterior end; coronoid moderately elongate, quadrate, truncate, directed almost perpendicular to median line of horizontal ramus; angle of mandible large and heavy (relatively longer than in *Scalopus*); inferior mandibular notch large, subcircular, relatively broad and deep.

*Dental characters.*—First upper incisor long and broad, convex anteriorly, flat posteriorly; second and third upper incisors and upper canine simple, conical, of moderate size, subequal, about two-thirds as long as first incisor. First, second, and third upper premolars similar to second and third incisors, the third premolar usually with a small postero-basal cusp; fourth premolar much larger than third, more cuspidate, with a large posterior cusp, usually with an intero-basal cusplike process, and frequently with a more or less developed antero-basal cusplike process. Upper molars W-shaped in transverse section, with an antero-internal V-shaped cusplike shelf (not lobed); first and second molars subequal, the third much smaller.

First seven lower teeth (incisors, canine, and first, second, and third premolars) small, conical, the first and third incisors smaller than the other teeth, which are subequal; premolars each with a



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FIG. 11.—Hind foot of *S. l. latimanus* (X 1½). Individual referred to in fig. 8.

slight cusplike process posteriorly; fourth premolar much larger, more cuspidate. Lower molars M-shaped in transverse section, the antero-internal cusp bilobed; first molar with a postero-internal basal accessory cusp; second molar with a postero- and an antero-internal basal accessory cusp; third molar with an antero-internal basal accessory cusp; first and second molars subequal, the third much smaller. Dentition: i.  $\frac{3}{3}$ ; c.  $\frac{1}{1}$ ; pm.  $\frac{4}{4}$ ; <sup>1</sup> m.  $\frac{3}{3}$ ; total 44.

### Key to Species and Subspecies of Scapanus.

[Based upon specimens of adult animals in fresh pelage.]

- a<sup>1</sup>. Unicuspid teeth evenly spaced and not crowded; rostrum relatively long and narrow; color dark, almost black (except in *Scapanus orarius schefferi*).
- b<sup>1</sup>. Total length more than 200 mm.; greatest length of skull more than 40 mm.; sublachrymal-maxillary ridge distinct.....*Scapanus townsendii* (p. 58).
- b<sup>2</sup>. Total length less than 200 mm.; greatest length of skull less than 40 mm.; sublachrymal-maxillary ridge not much developed.
- c<sup>1</sup>. Color darker; rostrum narrow; interorbital breadth of skull 8.2 mm. or less, *Scapanus orarius orarius* (p. 61).
- c<sup>2</sup>. Color paler; rostrum relatively broad; interorbital breadth of skull 8.2 mm. or more.....*Scapanus orarius schefferi* (p. 63).
- a<sup>2</sup>. Unicuspid teeth usually crowded and not evenly spaced; rostrum relatively short and broad; color usually brown or gray, seldom almost black.
- b<sup>1</sup>. Total length usually less than 165 mm.; greatest length of skull 33.5 mm. or less.
- c<sup>1</sup>. Greatest length of skull less than 31 mm.; premolars  $\frac{3}{3}$ , *Scapanus anthonyi* (p. 75).
- c<sup>2</sup>. Greatest length of skull 31 mm. or more; premolars  $\frac{4}{4}$ .
- d<sup>1</sup>. Interorbital constriction more than 7.6 mm.; breadth of skull across mastoids more than 16.2 mm.....*Scapanus latimanus grinnelli* (p. 69).
- d<sup>2</sup>. Interorbital constriction 7.6 mm. or less; breadth of skull across mastoids 16.2 mm. or less.
- e<sup>1</sup>. Inferior mandibular notch deep; geographic range south of latitude 37° N.....*Scapanus latimanus occultus* (p. 68).
- e<sup>2</sup>. Inferior mandibular notch shallow; geographic range north of latitude 37° N.....*Scapanus latimanus minusculus* (p. 72).
- b<sup>2</sup>. Total length usually more than 165 mm.; greatest length of skull more than 33.5 mm.
- c<sup>1</sup>. Geographic range, California west of Sacramento and San Joaquin Valleys, including also Klamath Canyon.....*Scapanus latimanus latimanus* (p. 64).
- c<sup>2</sup>. Geographic range, Oregon and California east of Sacramento and San Joaquin Valleys, except Klamath Canyon.
- d<sup>1</sup>. Color dark; interorbital constriction less than 7.6 mm., *Scapanus latimanus sericatus* (p. 71).
- d<sup>2</sup>. Color pale; interorbital constriction more than 7.6 mm.
- e<sup>1</sup>. Greatest length of skull less than 36 mm., *Scapanus latimanus dilatus* (p. 72).
- e<sup>2</sup>. Greatest length of skull more than 36 mm., *Scapanus latimanus alpinus* (p. 75).

<sup>1</sup> Pm.  $\frac{3}{3}$  in the type and only specimen of *Scapanus anthonyi*.

Descriptions of Species and Subspecies of *Scapanus*.

## SCAPANUS TOWNSENDII (Bachman).

## TOWNSEND'S MOLE.

(Pl. IV, fig. 1; Pl. V, figs. 1, 1a; Pl. VI, fig. 10.)

*Scalops canadensis* Richardson, Fauna Boreali-Amer., part 1, p. 9, 1829. (Not of Desmarest or Harlan.)*Scalops Townsendii* Bachman, Journ. Acad. Nat. Sci., Philadelphia, vol. 8, part 1, p. 58, 1839.*Scalops Townsendi* Bachman, Boston Journ. Nat. Hist., vol. 4, p. 31, January, 1842.*Scapanus Townsendii* (sic) Pomel. Archiv. Sci. Physiques et Nat., vol. 9, p. 247, 1848.*Scalops metallescens* Cassin, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 242, 1854. (Nomen nudum.)*Scalops æneus* Cassin, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 299, 1854. Type locality, Oregon.[*Talpa*] *ænea* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.*Talpa Townsendii* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.*Talpa tæniata* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854. Type locality, banks of Columbia River.[*Scapanus*] *Townsendi* Peters, Monatsber. Königl. Preuss. Akad. Wissensch., Berlin, 1863, p. 656, 1864.*Scapanus Townsendii* True, Proc. U. S. Nat. Mus., vol. 7, p. 607, 1885.*Type locality*.—"Banks of the Columbia River." Probably from the vicinity of Fort Vancouver, Clarke County, Washington, which it seems well to consider the type locality.*Type specimen*.—Cotype, No. 449, Acad. Nat. Sci. Philadelphia; collected May 9, 1835,<sup>1</sup> by J. K. Townsend.*Geographic range*.—Extreme northwestern California, Oregon, and Washington west of the Cascade Mountains.*General characters*.—Size largest of the genus; color dark, almost black; skull large, mastoids relatively heavy, rostrum long; unicuspid teeth evenly spaced and not crowded. The young of *S. townsendii* in superficial skin characters often resemble adults of *S. orarius*, but are easily separated from the latter by their large fore feet, with thick, heavy claws.*Color*.—*Winter pelage*: Upperparts blackish brown, fuscous-black, sooty black, to almost black, usually with a purplish sheen; underparts very slightly paler than the back and frequently stained with brown. *Summer pelage*: Much like winter pelage, but very slightly paler, with purplish sheen more pronounced.*Skull*.—Large (greatest length of smallest skulls more than 40 mm.), flat, and angular; mastoids angular and rather heavy; interparietal relatively narrower antero-posteriorly than in *S. latimanus*; slight but distinct sagittal crest between anterior portions<sup>1</sup> The date is not on the labels now attached to the specimen, but Bachman (loc. cit.) states it was collected May 9, 1835.



of parietals in adults; zygomata heavy; rostrum long and relatively narrow; sublachrymal-maxillary ridge well developed; dentition heavy; unicuspid teeth, both maxillary and mandibular, evenly spaced and not crowded as in *latimanus*; mandible relatively weaker than in *latimanus*.

*Measurements*.—Average of 3 young adult females from vicinity of Portland, Oreg.: Total length, 206 (195–222); tail vertebræ, 48.3 (45–51); hind foot, 26.3 (24–28). Average of 7 adult males from Ferndale, Humboldt County, Cal.: 224.1 (217–237); 41.1 (34–50); 26.7 (26–27). Average of 4 adult females from Ferndale, Cal.: 208 (202–210); 41.8 (37–46); 26.8 (26–27). *Skull*: Average of 10 skulls of adult males from Puyallup, Wash.: Greatest length, 43.6 (42.3–44.6); palatilar length, 18.1 (17.4–18.8); mastoidal breadth, 20.8 (20.3–21.4); interorbital breadth, 9.2 (9.1–9.4); maxillary tooth row, 14.1 (13.7–14.4); mandibular molar-premolar row, 13.8 (13.5–14.4). Average of 10 skulls of adult females from Puyallup, Wash.: Greatest length, 42.3 (41.5–44.1); palatilar length, 17.6 (16.9–18.1); mastoidal breadth, 19.9 (19.3–20.4); interorbital breadth, 8.9 (8.4–9.2); maxillary tooth row, 13.9 (13.5–14.4); mandibular molar-premolar row, 13.6 (13.2–14). Average of 3 skulls of young adult females from the vicinity of Portland, Oreg.: Greatest length, 41.8 (41.2–42.1); palatilar length, 17.6 (17.3–18); mastoidal breadth, 19.8 (19.4–20); interorbital breadth, 9 (8.7–9.1); maxillary tooth row, 13.4 (13.3–13.5); mandibular molar-premolar row, 13.2 (13.1–13.3). Average of 7 skulls of adult males from Ferndale, Humboldt County, Cal.: Greatest length, 42.9 (42.3–44.2); palatilar length, 18.3 (17.7–18.7); mastoidal breadth, 20.9 (20–21.8); interorbital breadth, 9 (8.7–9.5); maxillary tooth row, 13.9 (13.5–14.2); mandibular molar-premolar row, 13.7 (13.2–14.1). Average of 4 skulls of adult females from Ferndale, Cal.: Greatest length, 41.5 (41.2–41.9); palatilar length, 17.9 (17.8–18); mastoidal breadth, 20 (19.9–20.2); interorbital breadth, 8.9 (8.7–9.1); maxillary tooth row, 13.7 (13.5–13.9); mandibular molar-premolar row, 13.3 (13.2–13.5).

*Remarks*.—The presence of moles in the Pacific northwest was known to some of the early explorers, but the first one described was by Richardson,<sup>1</sup> who, though very accurately describing the animal now known as *Scapanus townsendii*, referred his specimens to the common mole of eastern United States, then known as *Scalops canadensis* Desmarest. It was not until ten years later that the species was named, when Bachman<sup>2</sup> published his description based upon two specimens. One specimen was a normally colored individual received from Nuttall from a locality not stated; the other was collected by Townsend and according to Bachman (loc. cit.) was

<sup>1</sup> Richardson, J., *Fauna Boreali-Amer.*, part 1, pp. 9–12, 1829.

<sup>2</sup> Bachman, J., *Journ. Acad. Nat. Sci. Philadelphia*, vol. 8, part 1, pp. 58–60, 1839.

labeled "Banks of the Columbia River, May 9, 1835." The latter specimen is a partial albino, having a narrow, irregular white streak extending from chin to abdomen, and another from forehead to snout; this specimen (No. 449) is now in the Academy of Natural Sciences of Philadelphia, where sometime in later years it was marked "Type of *Scalops townsendii*." It is not the type, since Bachman's description was based in part if not primarily on the specimen submitted by Nuttall; it may well be considered a cotype, however, since Bachman does not designate a type; that he considered the two specimens one and the same species is evident in his remark: "I subsequently received from Mr. Townsend another specimen, a little larger in size, which I presume to be a mere variety, although very singularly marked" (loc. cit., p. 58). This same abnormal specimen became, in 1854, the type of *Talpa tæniata* Le Conte. Cassin exhibited and described a mole which he called "*Scalops metallescens*" before the Philadelphia Academy in 1853, but in the published account<sup>1</sup> of his talk and exhibition, which appeared the next year, the name "*Scalops metallescens*" occurs without any description. Subsequently, however, Cassin<sup>2</sup> described the animal under the name "*Scalops æneus*;" the type<sup>3</sup> is now in the United States National Museum. Cassin states: "In its dentition and otherwise it is a strict congener of *Scalops townsendii*, but is much smaller and of a different color. Its black claws are especially remarkable, and distinguish it from all other species of the genus" (loc. cit.). Unfortunately the skull has been lost, but the skin seems to show that it is of a rather young specimen of *Scapanus townsendii* which has been shrunk and discolored by some chemical, possibly corrosive sublimate. The general tone of color of the back is between Brussels brown and Prout's brown; the underparts are mostly buckthorn brown, and on chin and ankles is a suspicious tinge of sulphine yellow. The claws are heavy as in *townsendii* and do not indicate specific relationship with *S. orarius*; both claws and soles of the feet are black, which might readily be accounted for by the presence of mercuric sulphid from the combination of carbon bisulphid and corrosive sublimate used in preserving specimens.

Townsend's mole, though showing considerable individual variation in size and in proportions and shape of skull, is subject to very little geographic variation. In a large series of skulls from Puyallup, Wash., are four which have supernumerary premolars. Three of these have each an extra premolar between the second and third premolars of the right mandible; the other specimen has a supernumerary tooth between the second and third premolars of the left

<sup>1</sup> Cassin, J., Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 242, 1854.

<sup>2</sup> Cassin, loc. cit., p. 299, 1854.

<sup>3</sup> No. 3725, U. S. Nat. Mus., skin without skull; collected in Oregon, by "U. S. Exploring Expedition."



mandible, and a minute extra tooth between the third and fourth right lower premolars. This is interesting since *Scapanus* normally has the theoretically complete mammalian dentition of 44 teeth.

*Specimens examined*.—Total number, 203, as follows:

**California:** Crescent City, 6; Ferndale, 11;<sup>1</sup> Smith River, 2.

**Oregon:** Beaverton, 3; Coquille, 1; Drain, 1; Goldbeach, 2; Grants Pass, 1; Netarts, 1;<sup>2</sup> Oregon City, 3; Portland, 24;<sup>2, 3, 4</sup> Salem, 3; Seaton, 1; "U. S. Exploring Expedition," 1; Wells, 1.

**Washington:** Columbia River (type locality), 1;<sup>5</sup> Hot Springs Trail, Olympic Mountains, 1;<sup>6</sup> Lake Cushman, 2; La Push, 1; Puyallup, 108;<sup>7</sup> Renton, 1;<sup>1</sup> Roy, 1; Sauk, 1; Seattle, 1; Skykomish, 1; South Bend, 5; Steilacoom, 3; Tacoma, 1;<sup>5</sup> Tenino, 3; Vancouver, 11; Vancouver Barracks (probably exact type locality), 1.

### SCAPANUS ORARIUS ORARIUS True.

#### COAST MOLE.

(Pl. IV, fig. 2; Pl. V, figs. 2, 2a; Pl. VI, fig. 11.)

*Scapanus orarius* True, Proc. U. S. Nat. Mus., vol. 19, p. 52, December 21, 1896.

*Type locality*.—Shoalwater Bay, Pacific County, Washington.

*Type specimen*.—No.  $\frac{1381}{37434}$ , U. S. Nat. Mus.; ♀ young adult, skin and skull (posterior portion of braincase broken and incomplete); collected August 30, 1855, by J. G. Cooper.

*Geographic range*.—Humid coast region of northern California (north of Mendocino), Oregon, and Washington.

*General characters*.—Size medium; color dark. The subspecies *orarius* is somewhat smaller than *S. l. latimanus*, with relatively smaller fore feet, and slenderer claws; darker than *latimanus*. Similar in color to *S. townsendii*, but very much smaller, with actually and relatively smaller feet and claws. The skull of *S. o. orarius* can always be easily distinguished from that of *townsendii* by its much smaller size, without reference to any other characters; from that of *latimanus* it differs in its evenly spaced and uncrowded unicuspid teeth, its very narrow rostrum, undeveloped and indistinct sublachrymal-maxillary ridge, and very weak mandible; teeth, particularly the first incisors, smaller than in *latimanus*.

*Color*.—General tone much the same as in *S. townsendii*. *Winter pelage*: Upperparts fuscous-black, chætura black, blackish brown, to nearly black; underparts slightly paler and more grayish. *Summer pelage*: Much like winter pelage but usually more brownish.

*Skull*.—Size medium (average greatest length of skulls of adult males about 34 to 35 mm.); mastoid region weak; sublachrymal-maxillary ridge only slightly developed; rostrum very narrow;

<sup>1</sup> Collection Mus. Vert. Zool., Univ. California.

<sup>2</sup> Collection Oregon State Game Comm.

<sup>3</sup> Collection of H. E. Anthony, New York City.

<sup>4</sup> Collection of S. G. Jewett, Portland, Oreg.

<sup>5</sup> Collection Acad. Nat. Sci. Philadelphia.

<sup>6</sup> Collection Field Mus. Nat. Hist.

<sup>7</sup> One hundred, skulls only; two skeletons.

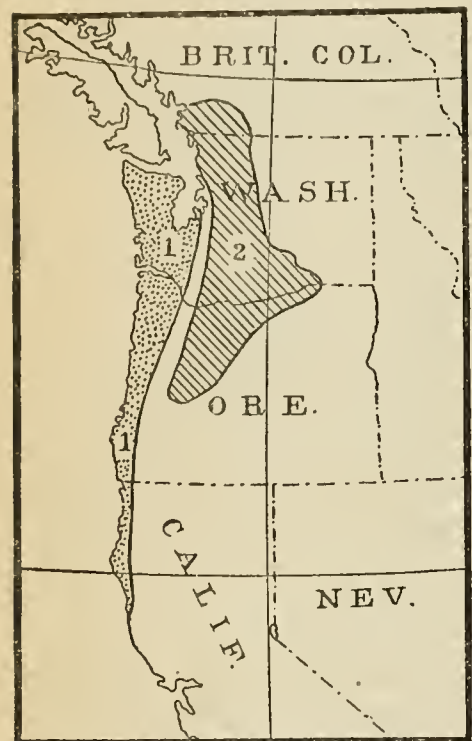


horizontal ramus of mandible narrow and weak; teeth, especially first incisors, small.

**Measurements.**—Average of 3 adult males from Eureka, Humboldt County, Cal.: Total length, 167 (163–175); tail vertebrae, 33.7 (31–35); hind foot, 20.7 (20–22). **Skull:** Average of 2 skulls of adult males from Ferndale, Humboldt County, Cal.: Greatest length, 34.3 (33.5–35); palatilar length, 13.5 (13.3–13.7); mastoidal breadth, 16.4 (16.3–16.4); interorbital breadth, 8.1 (8–8.1); maxillary tooth row, 10.7 (10.5–10.9); mandibular molar-premolar row, 10.4 (10.3–10.5).

**Remarks.**—Judged by the specimens examined, *Scapanus orarius* (including the subspecies *schefferi*) has a more extensive geographic range than *S. townsendii*; it occurs both farther north and farther south, as well as much farther east (fig. 12). The ecological relationship of the two forms is unknown; its solution would involve most valuable and interesting research for some student favorably situated.

The few specimens of *S. o. orarius* available from the region of the type locality are mostly of young animals or have imperfect skulls. However, there seems to be very little geographic variation, either chromatic or cranial, in



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FIG. 12.—Geographic range of the subspecies of *Scapanus orarius*.

1. *S. o. orarius*.      2. *S. o. schefferi*.

specimens taken throughout the whole coastal strip extending from Juan de Fuca to Mendocino County, Cal.

**Specimens examined.**—Total number, 46, as follows:

**California:** Crescent City, 3; Cuddeback, 1;<sup>1</sup> Eureka, 6;<sup>1</sup> Ferndale, 2;<sup>1</sup> Mendocino, 1;<sup>2</sup> Orick, 1; Smith River, 1.

**Oregon:** Astoria, 1;<sup>3</sup> Myrtle Point, 1; Newport, 1; Portland, 3;<sup>4</sup> Yaquina Bay, 4.

**Washington:** Chehalis County, 1; King County, 1;<sup>5</sup> La Push, 1; Neah Bay, 2; Pacific County, 1;<sup>6</sup> Port Townsend, 1; Puyallup, 6; Shoalwater Bay (type locality), 2; South Bend, 5; Steilacoom, 1.

<sup>1</sup> Collection Mus. Vert. Zool., Univ. California.

<sup>2</sup> Collection Field Mus. Nat. Hist.

<sup>3</sup> Collection Univ. Michigan Mus.

<sup>4</sup> Collection of H. E. Anthony, New York City.

<sup>5</sup> Collection Milwaukee Public Mus.

<sup>6</sup> Collection Amer. Mus. Nat. Hist.

SCAPANUS ORARIUS SCHEFFERI subsp. nov.<sup>1</sup>

SCHEFFER'S MOLE.

(Pl. IV, fig. 3; Pl. VI, fig. 12.)

*Type locality*.—Walla Walla, Walla Walla County, Washington.

*Type specimen*.—No. 204997, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected August 8, 1914, by Theodore H. Scheffer.

*Geographic range*.—Extreme southwestern British Columbia, northwestern Washington (east of Puget Sound and north of latitude 48° N.), central and southern Washington from the west slopes of the Cascade Mountains east to Walla Walla, and both slopes of the Cascade Mountains in northern and east-central Oregon.

*General characters*.—Similar to *S. o. orarius* but much paler, slightly larger, with both hind and fore feet relatively larger, and claws heavier. Skull about the size of that of *orarius*, with relatively shorter and broader rostrum and greater interorbital breadth.

*Color*.—*Fresh autumn pelage*: Upperparts glossy deep mouse gray; underparts slightly paler and more grayish. *Worn summer pelage*: Upperparts hair-brown to pale fuscous; underparts mouse gray.

*Skull*.—Compared with that of *S. o. orarius*, the skull of *schefferi* is broader interorbitally and has a relatively and actually shorter and broader rostrum, more evident sublachrymal-maxillary ridge, heavier mandible, and heavier dentition.

*Measurements*.—Type (adult male): Total length, 170; tail vertebrae, 35; hind foot, 23. Average of 3 adult males (including type) from type locality: 168.7 (165–171); 34.7 (34–35); 23 (23–23).

*Skull*: Type (adult male): Greatest length, 34.7; palatilar length, 14.6; mastoidal breadth, 16.7; interorbital breadth, 8.4; maxillary tooth row, 11.2; mandibular molar-premolar row, 10.9. Average of 3 skulls of adult males (including type) from the type locality: Greatest length, 34.4 (34.2–34.7); palatilar length, 14.4 (14.2–14.6); mastoidal breadth, 16.4 (16.2–16.7); interorbital breadth, 8.3 (8.2–8.4); maxillary tooth row, 11.1 (11–11.2); mandibular molar-premolar row, 10.8 (10.8–10.9). Average of 2 skulls of adult females from the type locality: Greatest length, 32.9 (32.8–39); palatilar length, 13.7 (13.6–13.8); mastoidal breadth, 15.9 (15.8–15.9); interorbital breadth, 8.2 (8.2–8.2); maxillary tooth row, 10.6 (10.6–10.6); mandibular molar-premolar row, 10.4 (10.3–10.5).

*Remarks*.—Typical specimens of *schefferi* are easily distinguishable from *S. o. orarius*, its most closely allied form. The type specimen has fresh autumn pelage on the upperparts, the underparts still retaining the worn summer pelage. On the face of the type specimen

<sup>1</sup> Named for Theodore H. Scheffer in recognition of his careful investigations of the habits and ecology of American moles.

is a small spot of ochraceous-buff and a faint wash of the same color on the throat. Similar chromatic abnormalities crop out in several specimens from the type locality, and one specimen (No. 204998, U. S. Nat. Mus.) has as a dental abnormality a supernumerary left upper premolar.

Intergradation of this form with *orarius* is clearly indicated in specimens from the west slope of the Cascade Mountains in Oregon and Washington. Specimens from Vida, McKenzie Bridge, and Three Sisters, in Oregon, approach *orarius* in color and in cranial characters, though distinctly referable to *schefferi*. Specimens from Mount Vernon, Wash., are slightly darker in color than specimens from Walla Walla, but the skulls are almost identical in essential characters with the type series. Specimens from Skykomish, Wash., are nearly as dark as typical *orarius*, but are referred to *schefferi* because of cranial characters which, although approaching *orarius*, are much nearer *schefferi*.

*Specimens examined*.—Total number, 59, as follows:

**British Columbia:** Chilliwaek Valley, 2; Chiloweyuck Depot, 2; Fraser River (near New Westminster), 1;<sup>1</sup> Sumas, 6.

**Oregon:** McKenzie Bridge, 2; Three Sisters, 2; Vida, 4.

**Washington:** Easton, 4; Fort Walla Walla, 4; Lester, 4; Merritt, 5; Mount Vernon, 2; North Yakima, 5; Skykomish, 6; Walla Walla (type locality), 5; Wenatchee, 5.

#### SCAPANUS LATIMANUS LATIMANUS (Bachman).

##### CALIFORNIA MOLE.

(Pl. IV, fig. 4; Pl. V, figs. 3, 3a; Pl. VI, fig. 13.)

*Scalops latimanus* Bachman, Boston Journ. Nat. Hist., vol. 4, p. 34, 1842.

*Scalops californicus* Ayres, Proc. California Acad. Sci., vol. 1, p. 54, 1856. Type locality, San Francisco, California.

*Scapanus californicus* True, Proc. U. S. Nat. Mus., vol. 19, p. 52, December 21, 1896.

*Scapanus latimanus* Osgood, Proc. Biol. Soc. Washington, vol. 20, p. 52, April 18, 1907.

*Scapanus latimanus latimanus* Miller, U. S. Nat. Mus., Bul. 79, p. 9, December 31, 1912.

*Type locality*.—Probably Santa Clara, Santa Clara County, California.<sup>2</sup>

*Type specimen*.—Mounted specimen, with imperfect skull, in the Berlin Museum; collected during October, 1834.

*Geographic range*.—Western California west of the San Jacinto and Sacramento Valleys, from Santa Maria River north to Cape Mendocino, thence northeasterly to Klamath Canyon, Siskiyou County.

*General characters*.—Size medium (length of adults usually about 170 to 180 mm.); color fuscous or drab to chætura black, most frequently chætura drab; skull flat, rather massive in the maxillary

<sup>1</sup> Collection Amer. Mus. Nat. Hist.

<sup>2</sup> Vide Osgood, W. H., Proc. Biol. Soc. Washington, vol. 20, p. 52, 1907.



region; rostrum short and relatively heavy; unicuspid teeth irregular and crowded.

*Color*.—*Fresh winter pelage*: Above, fuscous-black, chætura drab, or chætura black; old and faded specimens more brownish, fuscous to mummy brown; beneath, much as above but paler, usually slightly more grayish, and frequently stained with brown mid-ventrally. *Summer pelage*: Usually paler and slightly more brownish than winter pelage, drab, hair-brown, or chætura drab, paler beneath. *Young*: Usually darker and more grayish than adults.

*Skull*.—Size medium, flat; sublachrymal-maxillary ridge heavy and well defined; rostrum short and broad; unicuspid teeth irregular in size, and crowded; second lower incisor caninelike, larger, and longer than either the first or the third incisor. The skull of *S. l. latimanus* is very much smaller than that of *S. townsendii*, the skulls of large adult males of *latimanus* being smaller than the skulls of small adult females of *townsendii*; the rostrum of *latimanus* is relatively shorter and broader than that of *townsendii*, and the unicuspid teeth are more irregular in size and shape, and more crowded. Compared with *S. o. orarius* the skull of *latimanus* is wider and much heavier, with less rounded and more truncate braincase, much shorter and broader rostrum, much heavier sublachrymal-maxillary ridges, larger teeth, and heavier horizontal rami of mandibles. The skull of typical *latimanus* is larger than that of any other subspecies of *S. latimanus* except *S. l. alpinus*, from which it is indistinguishable.

*Measurements*.—Adult male from Gilroy, Santa Clara County, Cal.: Total length, 173; tail vertebræ, 35; hind foot, 23. Average of 4 young adult males from Santa Cruz, Cal.: 175.8 (173–181); 33.3 (32–38); 20.8 (20–21). Average of 4 young adult females from Santa Cruz, Cal.: 171.5 (162–185); 32.5 (31–35); 20.8 (20–21). *Skull*: Adult male from Gilroy, Santa Clara County, Cal.: Greatest length, 36.2; palatilar length, 14.4; mastoidal breadth, 17.3; interorbital breadth, 7.8; maxillary tooth row, 11.2; mandibular molar-premolar row, 10.9. Average of 4 skulls of young adult males from Santa Cruz, Cal.: Greatest length, 36.1 (35.7–36.6); palatilar length, 14.2 (13.8–14.6); mastoidal breadth, 17 (16.9–17.3); interorbital breadth, 7.8 (7.5–8); maxillary tooth row, 11 (10.8–11.1); mandibular molar-premolar row, 10.6 (10.5–10.8). Average of 7 skulls of adult males from Nicasio, Cal.: Greatest length, 37.1 (36.6–37.4); palatilar length, 14.5 (14.3–14.7); mastoidal breadth, 17.3 (17–17.8); interorbital breadth, 7.8 (7.5–7.9); maxillary tooth row, 11.3 (11.1–11.6); mandibular molar-premolar row, 11 (10.7–11.4). Average of 4 skulls of young adult females from Santa Cruz, Cal.: Greatest length, 34.7 (34.4–35); palatilar length, 13.8 (13.4–14.1); mastoidal breadth, 16.8 (16.6–17); interorbital breadth, 7.8 (7.7–8); maxillary

tooth row, 10.7 (10.4–10.9); mandibular molar-premolar row, 10.3 (10.1–10.5). Average of 5 skulls of adult females from Nicasio, Cal.: Greatest length, 36 (35.3–36.6); palatilar length, 14.1 (13.7–14.5); mastoidal breadth, 16.9 (16.7–17.2); interorbital breadth, 7.7 (7.4–8.1); maxillary tooth row, 11.1 (10.8–11.4); mandibular molar-premolar row, 10.8 (10.3–11.1).

*Remarks.*—Bachman's name *latimanus* was placed in synonymy under *Scapanus townsendii* by Peters<sup>1</sup> where it remained until Osgood showed that it did not apply to *townsendii* but to the mole of west-central California, then known as *Scapanus californicus* (Ayres). Osgood writes:

As stated by Peters (loc. cit.), it [the type specimen] was transmitted by Deppe from Monterey, California. It was collected in October, 1834, at Santa Clara, not a Mexican locality,<sup>2</sup> as suggested by Peters, but doubtless the town of that name in California not very distant from Monterey. Only one species of mole is known to occur at this locality, and the specimen is typical of this species. The hind foot to end of claws measures 18.7 mm. The fragmentary skull, which Dr. Matschie caused to be removed from the mounted specimen, presents the following measurements, all decidedly smaller than *S. townsendii*: Length of upper tooth row from front of incisor to back of last molar, 15.4; of lower tooth row, 13.7; outside width at second upper molar, 10.2.<sup>3</sup>

The measurements given by Osgood are somewhat less than those of skulls of adults from the vicinity of Santa Clara, Cal., but this may possibly be due to immaturity of the type specimen. The animal is certainly not *townsendii*, and it seems best to accept Osgood's verdict and place *californicus* in synonymy under *latimanus*.

A skeleton<sup>4</sup> of this species in the United States National Museum has been set aside as the type of *Scalops californicus* Ayres, and of it Lyon and Osgood state: "This skeleton is one of Dr. Ayres's original specimens, and probably the only one of them now in existence. It seems well to treat it as a type, although it was not so indicated by the original describer."<sup>5</sup> However, there seems to be no good reason for designating this specimen as the type of *californicus*; it was entered in the museum catalogue February 14, 1857, but in the collection are two other specimens (alcoholic) which Lyon and Osgood apparently overlooked. One<sup>6</sup> of these, without the date of collection, was entered in the catalogue May 4, 1857; the other,<sup>7</sup> collected several weeks after Ayres had read his description before the California Academy of Sciences, was entered in the museum catalogue

<sup>1</sup> Peters, W., Monatsber. Konig. Preuss. Akad. Wissensch., Berlin, 1863, p. 656, 1864.

<sup>2</sup> At the time the specimen was collected California was part of Mexico. Peters, however, states "in Sta. Clara (Sonora?) gesammelt worden."

<sup>3</sup> Osgood, W. H., Proc. Biol. Soc. Washington, vol. 20, p. 52, 1907.

<sup>4</sup> No. 3111, U. S. Nat. Mus., skeleton (lacking right manus and forearm, and left last upper molar); collected at San Francisco, Cal., by Dr. W. O. Ayres.

<sup>5</sup> Lyon, M. W., and Osgood, W. H., U. S. Nat. Mus., Bul. 62, p. 234, 1909.

<sup>6</sup> No. 2673, U. S. Nat. Mus., alcoholic; collected at San Francisco, Cal., by Dr. W. O. Ayres.

<sup>7</sup> No. 1288, U. S. Nat. Mus., alcoholic; collected at San Francisco, Cal., September, 1855, by Dr. W. O. Ayres.



February 4, 1856. Nothing in the original description would indicate that Ayres had any one particular specimen in mind; in the only place in his description where specimens are mentioned, he refers to the "color of fur, in the specimens seen."<sup>1</sup> Furthermore if Ayres set aside any specimen as the type it was probably in the Museum of the California Academy of Sciences, since preceding his original description the donation of five moles to the Academy was acknowledged and the following statement made concerning them: "In connection with these, Dr. Ayres presented the following description" (loc. cit.). It seems, therefore, that the specimens in the United States National Museum are not a part of Ayres's original series.

Slight local variations in size and shape of skull of *latimanus* might be worthy of subspecific recognition were they constant over any considerable geographic area. However, they are so slight and inconstant, and crop out so frequently, that to recognize them by subspecific appellation would only be confusing, and add nothing to the knowledge of the relationships of the group. Specimens from the coast region north of San Francisco Bay seem to average slightly larger and darker than typical specimens, but the difference is not sufficiently pronounced to warrant subspecific designation. Specimens examined from Klamath Canyon show little approach in color toward *S. l. dilatus*, but the skulls are shorter than in typical *latimanus*, showing in this respect intergradation with *dilatus*. Specimens from Lower Lake and Mount Sanhedrin are paler than typical *latimanus*, probably indicating an approach toward *dilatus*. Intergradation with *S. l. occultus* occurs in the region between Santa Margarita, in San Luis Obispo County, and Santa Barbara; a specimen from the former locality is clearly intermediate, but appears to be nearer *latimanus*.

*Specimens examined*.—Total number, 171, as follows:

**California:** Aptos, 1; Bells Station, 1; Berkeley, 8; Berryessa, 1; Beswick, 2; Bodega, 1; Bolinas, 1;<sup>2</sup> Boulder Creek, 1; Brentwood, 1; Briceland, 1; Cahto, 2; Carmel Point, 1;<sup>3</sup> Cazadero, 1; Colma, 1; Cuddeback, 2;<sup>2</sup> Eldridge, 7; Fort Bragg, 2; Freestone, 3;<sup>2</sup> Gilroy, 1; Gualala, 1; Guerneville, 3;<sup>2</sup> Haywards, 5; Hornbrook, 1; Inverness, 1; King City, 1; La Honda, 3;<sup>2,3</sup> Lower Lake 2;<sup>4</sup> Marin County, 1; Mendocino, 3;<sup>2,5</sup> Menlo Park, 8;<sup>2</sup> Monterey, 1;<sup>4</sup> Mount Sanhedrin, 1;<sup>2</sup> Napa, 1;<sup>2</sup> Nicasio, 54; Oakland, 4;<sup>6</sup> Pacific Grove, 1; Palo Alto, 1;<sup>4</sup> Petaluma, 2; Petrolia, 2; Piedmont, 1;<sup>2</sup> Point Arena, 1;<sup>2</sup> Point Reyes, 1; Red Bluff, 2;<sup>2</sup> Rockport, 2; San Francisco, 10; San Leandro, 3;<sup>2</sup> Santa Cruz, 9; Santa Margarita, 1;<sup>2</sup> Santa Rosa, 1;<sup>6</sup> Scott River, Siskiyou County, 1;<sup>2</sup> Snow Mountain, Colusa County, 1;<sup>4</sup> Stanford University, 1;<sup>2</sup> Stevens Creek, San Mateo County, 1;<sup>5</sup> Walnut Creek, Contra Costa County, 2.<sup>2</sup>

<sup>1</sup> Ayres, W. O., Proc. California Acad. Sci., vol. 1, p. 54, 1856.

<sup>2</sup> Collection Mus. Vert. Zool., Univ. California.

<sup>3</sup> Collection Amer. Mus. Nat. Hist.

<sup>4</sup> Collection Mus. Comp. Zool., Harvard College.

<sup>5</sup> Collection Field Mus. Nat. Hist.

<sup>6</sup> Collection Milwaukee Public Mus.



## SCAPANUS LATIMANUS OCCULTUS Grinnell &amp; Swarth.

## SOUTHERN CALIFORNIA MOLE.

(Pl. IV, fig. 5; Pl. VI, fig. 14.)

*Scapanus latimanus occultus* Grinnell & Swarth, Univ. California Publ. Zool., vol. 10, p. 131, April 13, 1912.

*Type locality*.—Santa Ana Canyon, west slope of north end of Santa Ana Mountains, Orange County, California; altitude 400 feet.

*Type specimen*.—No. 2369, Mus. Vert. Zool., Univ. California; ♀ young adult, skin and skull; collected September 20, 1908, by H. S. Swarth.

*Geographic range*.—Southern California west of the deserts, from Olancha, at the south end of Owens Lake, in Inyo County; Sanger, in Fresno County; and Santa Barbara, in Santa Barbara County, south to the San Diegan region.

*General characters*.—Size small (length of adults usually about 145 to 160 mm.); color in winter pelage paler and slightly more brownish than that of *S. l. latimanus*; color in summer pelage much like that of *latimanus*; skull small, weak; rostrum usually relatively longer and narrower than that of *latimanus*.

*Color*.—*Winter pelage*: In most specimens paler and more brownish than corresponding pelage of *S. l. latimanus*; upperparts chætura drab or fuscous, and occasionally, in much faded specimens, olive-brown or mummy brown; underparts somewhat paler and more grayish. *Summer pelage*: Very slightly paler than winter pelage; essentially like summer pelage of *latimanus*.

*Skull*.—Very similar to that of *S. l. latimanus* in general shape and proportions, but much smaller, and in most specimens with relatively longer and narrower rostrum.

*Measurements*.—Average of 13 young adult males from Compton, Los Angeles County, Cal.: Total length, 151.9 (140–165); tail vertebræ, 25.3 (22–29); hind foot (measured, from relaxed foot of dry skin, by the writer), 18.3 (17.5–19.5). Type (young adult female): 150; 33; 18. Two young adult females from Olancha, Owens Lake, Cal.: Total length, 148, 155; tail vertebræ, 30, 36; hind foot, 18, 19. *Skull*: Average of 13 skulls of young adult males from Compton, Los Angeles County, Cal.: Greatest length, 31.6 (30.7–32.8); palatilar length, 12.3 (12.1–12.8); mastoidal breadth, 15.4 (15–16); interorbital breadth, 7.1 (6.9–7.4); maxillary tooth row, 10 (9.7–10.3); mandibular molar-premolar row, 9.5 (9.3–9.9). Average of 4 skulls of adult males from Witch Creek, Cal.: Greatest length, 32.9 (32.6–33.5); palatilar length, 12.9 (12.7–13.2); mastoidal breadth, 15.8 (15.5–16.1); interorbital breadth, 7.3 (7.2–7.5); maxillary tooth row, 10.3 (10.1–10.5); mandibular molar-premolar row, 9.8 (9.6–10). Skull of type (young adult female): Greatest length, 31.5; palatilar

length, 12.3; mastoidal breadth, 15.6; interorbital breadth, 7.1; maxillary tooth row, 9.9; mandibular molar-premolar row, 9.4. Skulls of 2 young adult females from Olancho, Cal.: Greatest length, 31, 31.5; palatilar length, 12.2, 12.6; mastoidal breadth, 15.1, 15.6; interorbital breadth, 7.2, 7.3; maxillary tooth row, 9.9, 10; mandibular molar-premolar row, 9.4, 9.6.

*Remarks.*—The mole of southern California is constant in characters over its entire range. The type of *occultus* is a young adult female; it has abnormal mandibular teeth; the right first lower premolar is absent, and the left first lower premolar is crowded back and inward, close to the second premolar and in the same enlarged socket with it. Specimens from Witch Creek are slightly larger than those from the type region. Toward the northern border of its range the subspecies shows a gradual increase in size until it intergrades with *S. l. latimanus* in the region north of Santa Barbara County. A young adult male from Tehachapi and a specimen from Santa Barbara approach *latimanus* in size. A male from Porterville, Tulare County, is larger and slightly darker than typical specimens of *occultus*, and has a relatively narrower skull, probably showing in these respects a tendency towards *S. l. sericatus*. An imperfect skeleton, with broken skull, from Sanger, Fresno County, is provisionally referred to *occultus*; in dentition and in the size and proportions of the mandible it is indistinguishable from specimens from the type region. Two females from the south end of Owens Lake are almost indistinguishable from typical *occultus*, their only approach toward *S. l. grinnelli* being in slightly higher braincase. The relationships of *occultus* with *Scapanus anthonyi* are not clear, but the differences in size and color alone are sufficient to separate the two forms, even though it should ultimately be proven that the dentition of the type of *anthonyi* is abnormal (p. 76).

*Specimens examined.*—Total number, 73, as follows:

**California:** Alhambra, 10; Canyada Laga, 4 miles north of Ventura, 1;<sup>1</sup> Comp-ton, 21; Julian, 2;<sup>2</sup> Los Angeles, 3; Olancho, 2; Pasadena, 2;<sup>2</sup> Porterville, 1; Riverside, 1; San Bernardino, 5; San Bernardino Peak, 1; San Diego County, 5; San Gabriel, 1; Sanger, 1;<sup>2</sup> San Jacinto Mountains, 2;<sup>2</sup> Santa Ana Canyon (type locality), 1;<sup>2</sup> Santa Barbara, 1; Sierra Madre, Los Angeles County, 1;<sup>2</sup> Somerset, 4; Tehachapi, 1; Ventura, 1;<sup>2</sup> Warner Pass, San Diego County, 1;<sup>2</sup> Witch Creek, 5.

SCAPANUS LATIMANUS GRINNELLI Jackson.

GRINNELL'S MOLE.

(Pl. IV, fig. 6; Pl. VI, fig. 15.)

*Scapanus latimanus grinnelli* Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 56, March 20, 1914.

*Type locality.*—Independence, Inyo County, California; altitude 3900 feet.

<sup>1</sup> Collection Milwaukee Public Mus.

<sup>2</sup> Collection Mus. Vert. Zool., Univ. California.

*Type specimen*.—No. 17785, Mus. Vert. Zool., Univ. California; ♂ adult, skin and skull; collected May 8, 1912, by H. A. Carr.

*Geographic range*.—Known only from type locality.

*General characters*.—Size small; very slightly larger than average specimens of *S. l. occultus* or *S. l. minusculus*; smaller than *S. l. sericatus*; color darkest of the *latimanus* group; skull short and high, broad interorbitally and through mastoids; rostrum short and wide.

*Color*.—Type, in worn and somewhat faded *winter pelage*: Upperparts between fuscous and fuscous-black; underparts more grayish, stained on the throat and chest with Dresden brown. Topotype, in *fresh summer pelage*: Upperparts fuscous-black; underparts dark mouse gray.

*Skull*.—Short and high, not much depressed postorbitally, broad interorbitally and through the mastoids; posterior base of zygoma with a small inconspicuous process on outer lateral margin; rostrum short and wide; angle of mandible short and heavy. The skull of *grinnelli* is about the size of large skulls of *S. l. occultus*, but differs from them, in its higher braincase, its shorter and much broader rostrum, and in being much wider interorbitally and through the mastoids. It is much smaller and relatively shorter and wider than the skull of either *S. l. latimanus* or *S. l. sericatus*.

*Measurements*.—Type (adult male): Total length, 156; tail vertebræ, 31; hind foot, 21. Topotype (adult female): Total length, 158; tail vertebræ, 36; hind foot, 20.5 *Skull*: Type (adult male): Greatest length, 33; palatilar length, 13.1; mastoidal breadth, 17; interorbital breadth, 7.8; maxillary tooth row, 10.4; mandibular molar-premolar row, 10. Skull of topotype (adult female): Greatest length, 32.2; palatilar length, 12.8; mastoidal breadth, 16.4; interorbital breadth, 7.8; maxillary tooth row, 10.3; mandibular molar-premolar row, 9.9.

*Remarks*.—This form is a well-marked subspecies which can be separated from *S. l. occultus* either by skin or skull characters. Intergradation with *occultus* probably occurs in the region north or west of Owens Lake; a very slight indication of such intergradation is noticeable in specimens of *occultus* from Olancho. The topotype is peculiar in that the left upper tooth row contains a supernumerary premolar, apparently the one immediately posterior to the canine and probably derived from the anlage of the first premolar. As is the case in some specimens of *S. townsendii*, previously mentioned, this is especially interesting, since it gives this individual one more tooth than the theoretically complete mammalian dentition of 44 teeth.

*Specimens examined*.—Two, from type locality.<sup>1</sup>

<sup>1</sup> Collection Mus. Vert. Zool., Univ. California.



## SCAPANUS LATIMANUS SERICATUS Jackson.

## YOSEMITE MOLE.

(Pl. IV, fig. 7; Pl. VI, fig. 16.)

*Scapanus latimanus sericatus* Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 55, March 20, 1914.

*Type locality*.—Yosemite, Yosemite Valley, Mariposa County, California.

*Type specimen*.—No. 109548, U. S. Nat. Mus., Biological Survey collection; ♀ adult, skin and skull; collected August 20, 1901, by W. K. Fisher.

*Geographic range*.—Yosemite region, Mariposa County, Cal.

*General characters*.—Smaller than *S. l. latimanus*, darker and more grayish in fresh pelage; larger and darker than *S. l. occultus* or *S. l. minusculus*; claws, especially of fore feet, longer and more slender than those of *latimanus*; skull relatively long, narrow, and flat.

*Color*.—*Fresh summer pelage*: Upperparts fuscous-black; underparts more grayish, dark mouse gray. *Worn summer pelage*: Upperparts glossy olive-brown, underparts slightly paler.

*Skull*.—Relatively long, narrow, especially through mastoids; smaller than that of *S. l. latimanus*; larger than that of *S. l. occultus*, *S. l. minusculus*, or *S. l. grinnelli*; about equal in length to that of *S. l. dilatus*, but much narrower, and not so high through the braincase.

*Measurements*.—Two adult females, type and virtual topotype: Total length, 165, 171; tail vertebræ, 36, 34; hind foot, 21, 22. *Skull*: Skulls of two adult females, type and virtual topotype: Greatest length, 34.3, 34; palatilar length, 13.3, 13.7; mastoidal breadth, 16.2, 15.9; interorbital breadth, 7.2, 7.5; maxillary tooth row, 11, 10.8; mandibular molar-premolar row, 10.4, 10.4.

*Remarks*.—The skulls of the type and topotype<sup>1</sup> of *sericatus* show minor differences, but in essential features they are remarkably alike. They are very unlike the skull of *S. l. minusculus*, being distinctly larger, and with different proportions. The subspecies *sericatus* is intermediate in size between *S. l. latimanus* and *S. l. occultus*, and in fresh pelage is darker than either. The type of *sericatus* is mostly in worn summer pelage, fresh pelage appearing on the abdomen and flanks; the topotype is in fresh summer pelage. An adult male from Bower Cave, Mariposa County, is not typical of the subspecies; it has a shorter tail than specimens from the Yosemite Valley, and the skull is flatter and wider through the braincase than that of typical *sericatus*.

*Specimens examined*.—Total number, 3, as follows:

**California**: Bower Cave, 1; Yosemite (type locality), 1; Yosemite Valley, 1.<sup>2</sup>

<sup>1</sup> No. 12980, Mus. Vert. Zool., Univ. California.

<sup>2</sup> Collection Mus. Vert. Zool., Univ. California.

## SCAPANUS LATIMANUS MINUSCULUS Bangs.

SIERRA MOLE.

(Pl. IV, fig. 8; Pl. VI, fig. 17.)

*Scapanus californicus minusculus* Bangs, Proc. New England Zool. Club, vol. 1, p. 70, July 31, 1899.

*Scapanus latimanus minusculus* Miller, U. S. Nat. Mus., Bul. 79, p. 10, December 31, 1912.

*Type locality*.—Fyffe, El Dorado County, California.

*Type specimen*.—No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ young adult, skin and skull; collected July 15, 1897, by W. W. Price and E. M. Nutting.

*Geographic range*.—Known only from type locality.

*General characters*.—Similar in size and color to *S. l. occultus*, possibly very slightly larger; skull higher and narrower through braincase than that of *occultus*; inferior mandibular notch very shallow, the angle of mandible being much shorter than in *occultus*.

*Color*.—Type, in *summer pelage*: Upperparts hair-brown; underparts deep mouse gray.

*Skull*.—Much like that of *S. l. occultus*, but braincase narrower, higher, and more rotund; inferior mandibular notch very shallow, much shallower than in *occultus*; angle of mandible short and weak.

*Measurements*.—Type (young adult female): Total length, 160; tail vertebræ, 31; hind foot, 21. *Skull*: Type (young adult female): Greatest length, 31.9; palatilar length, 12.6; mastoidal breadth, 15.3; interorbital breadth, 7.1; maxillary tooth row, 10; mandibular molar-premolar row, 9.7.

*Remarks*.—The type and only-known specimen of *minusculus* is a female, barely adult, the status of which can not be determined until more specimens are obtained from the type locality. The essential differences from *S. l. occultus* are in the skull, which is relatively narrower and higher and with the inferior mandibular notch very shallow; the hind foot is longer than that of *occultus*. This form, however, seems to be isolated from *occultus* by the interception of *sericatus*. In color the type of *minusculus* is much like some specimens of *S. l. dilatus*.

*Specimen examined*.—One, the type.

## SCAPANUS LATIMANUS DILATUS True.

KLAMATH MOLE.

(Pl. IV, fig. 9; Pl. VI, fig. 18.)

*Scapanus dilatus* True, Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

*Scapanus truei* Merriam, Proc. Biol. Soc. Washington, vol. 11, p. 102, April 26, 1897.

*Type locality*, Lake City, Modoc County, California.

*Scapanus truii* (sic) Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 469, 1905.

*Type locality*.—Fort Klamath, Klamath County, Oregon.

*Type specimen*.—No. 186628, U. S. Nat. Mus., Merriam collection; adult, sex unknown, skeleton; collected in 1883 by Charles E. Bendire.

*Geographic range*.—South-central Oregon and Upper Sonoran and Transition Zones of northeastern California and adjacent parts of Nevada.

*General characters*.—Similar to *S. l. latimanus*, but much paler and averaging slightly smaller; skull shorter, higher, and more rotund than in *latimanus*.

*Color*.—*Summer pelage*: Upperparts mouse gray, light drab, or drab, in some specimens becoming more brownish on the nose; underparts neutral gray, mouse gray, or smoke gray, sometimes tinged with light drab and occasionally stained in midventral line with Dresden brown.

*Skull*.—Smaller than that of *S. l. latimanus* or *S. l. alpinus*, relatively shorter, higher through the braincase, and relatively wider through the mastoids. About equal in length to the skull of *S. l. sericatus*, but relatively much wider and higher through the braincase.

*Measurements*.—Two adult males from McCloud, Cal.: Total length, 178, 170; tail vertebræ, 36, 42; hind foot, 21, 21. *Skull*: Type (sex unknown): Greatest length, 34.3; palatilar length, 13.6; mastoidal breadth, 16.8; interorbital breadth, 7.8; maxillary tooth row, 10.4;<sup>1</sup> mandibular molar premolar row, 10.3. Skulls of two adult males from McCloud, Cal.: Greatest length, 34.7, 35.2; palatilar length, 13.2, 13.7; mastoidal breadth, 17.3, 17.3; interorbital breadth, 7.8, 7.9; maxillary tooth row, 9.8, 10.3; mandibular molar premolar row, 9.5, 9.5.

*Remarks*.—True based his description of this form entirely upon the cranial characters of a specimen with abnormal dentition, there being in the type only three maxillary premolars. Later he placed the name in synonymy<sup>2</sup> under *Scapanus californicus* (= *S. l. latimanus*). The skull of the type, however, is relatively shorter and broader than that of typical *latimanus*. Unfortunately the exact color of the mole found at Fort Klamath, Oreg., is not known, there being no skins available from that locality; two alcoholics from the type locality, however, seem to indicate that the animal is pale, like the mole of northeastern California; from a geographic view point this is what one would anticipate; specimens from Ashland and Fremont, Oreg., are pale, like specimens from northeastern California, and those from Ashland have skulls inseparable from the skull of the type of *dilatus*. The type of *Scapanus truei* Merriam, which is now placed in synonymy under *dilatus*, is a rather

<sup>1</sup> Upper tooth formula abnormal: i. 3, c. 1, pm. 3, m. 3.

<sup>2</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 52, 1896.



young adult collected at Lake City, Modoc County, Cal.; in the original description Merriam mentions the following cranial and dental characters:

Skull similar to that of *S. californicus*, but slightly smaller, with narrower palate and decidedly narrower and more slender rostrum. Last upper premolar with a strongly developed, trenchant inner cusp, not present in *californicus*.<sup>1</sup>

The narrowness of the palate and rostrum is probably due in part to immaturity; the skull of a young adult female, which has been removed from an alcoholic specimen<sup>2</sup> from Fort Klamath, has the rostrum as narrow as that of the type of *truei* though it is slightly shorter. The presence of an inner cusp on the last upper premolar is not of diagnostic value. In any large series of *Scapanus* from a single locality this cusplike process may be present in various stages of development in about half the specimens; it appears more frequently in skulls of young individuals and seems to be absorbed with age. In the type of *truei* this accessory cusp has about reached its maximum development, yet in a specimen<sup>3</sup> collected as nearby as Cedarville, Modoc County, there is a barely perceptible trace of a cusp.

Considerable local geographic variations are observed in this form, but to recognize them by subspecific names would only be confusing. With a large series of specimens available from each of many localities it would be possible to learn more of the extent and relationships of these variations. Specimens from the upper Sacramento Valley show intergradation with *S. l. latimanus*, the color darkening and the skulls becoming larger and more elongate. A specimen from Fremont, Oreg., has certain cranial characters which suggest that *dilatatus* may possibly intergrade with *S. o. schefferi* in central Oregon.

*Specimens examined*.—Total number, 44, as follows:

**California:** Auburn, 1;<sup>4</sup> Baird, 1; Bald Mountain, 1; Cedarville, 1;<sup>5</sup> Chico, 1; Fort Crook, 1; Hayden Hill, 1; Lake City, 1; McCloud, 2; McCloud River, 1;<sup>5</sup> Millford, 2; Mosquito, El Dorado County, 1;<sup>6</sup> Mount Shasta, 1; Nevada City, 1; Parker Creek, Warner Mountains, 1;<sup>5</sup> Plumas County, 1;<sup>7</sup> Prattville, 1; Quincy, 4; Red Point, 1;<sup>4</sup> Round Mountain, Shasta County, 1; Sisson, 6;<sup>5</sup> Susanville, 4;<sup>4</sup> Tower House, Shasta County, 1.<sup>5</sup>

**Nevada:** Holbrook, 1.

**Oregon:** Ashland, 3; Fort Klamath (type locality), 3; Fremont, 1.

<sup>1</sup> Merriam, C. H., Proc. Biol. Soc. Washington, vol. 11, p. 102, 1897.

<sup>2</sup> No. 186627, U. S. Nat. Mus., Merriam collection.

<sup>3</sup> No. 16723, Mus. Vert. Zool., Univ. California.

<sup>4</sup> Collection Stanford Univ.

<sup>5</sup> Collection Mus. Vert. Zool., Univ. California.

<sup>6</sup> Collection Amer. Mus. Nat. Hist.

<sup>7</sup> Collection Carnegie Mus.

## SCAPANUS LATIMANUS ALPINUS Merriam.

## MOUNT MAZAMA MOLE.

*Scapanus alpinus* Merriam, Proc. Biol. Soc. Washington, vol. 11, p. 102, April 26, 1897.

*Type locality*.—Crater Lake, Mount Mazama, Klamath County, Oregon; altitude about 7000 feet.

*Type specimen*.—No. 79967, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected August 18, 1896, by Vernon Bailey.

*Geographic range*.—Known only from type locality.

*General characters*.—About the size of large specimens of *S. l. latimanus*, but much paler; hind foot large; indistinguishable in color from *S. l. dilatus*, but larger; skull like that of large specimens of *latimanus*, and much larger, flatter, and relatively longer and narrower than that of *dilatus*.

*Color*.—Worn summer pelage (type): Upperparts mouse gray; underparts (much worn) deep mouse gray; faded unworn pelage on throat and chest with a distinct buffy sheen.

*Skull*.—Similar to that of *S. l. latimanus*; indistinguishable from skulls of large adult males of *latimanus*.

*Measurements*.—Type (adult male): Total length, 188; tail vertebrae, 38; hind foot, 24.5. *Skull*: Type (adult male): Greatest length, 36.9; palatilar length, 14.6; mastoidal breadth, 17; interorbital breadth, 7.9; maxillary tooth row, 11.4; mandibular molar-premolar row, 11.3.

*Remarks*.—The subspecies *alpinus* is a poorly differentiated form having the color of *S. l. dilatus* and the size and skull proportions of large specimens of *S. l. latimanus*; it is not strictly intermediate between these two forms, however, since specimens of *latimanus* from southwest of Klamath Lake do not reach the maximum size. The type is a very old male with much-worn teeth; the skull is flattened by age and the cusps of the teeth are reduced through wear and absorption.

*Specimen examined*.—One, the type.

## SCAPANUS ANTHONYI Allen.

## ANTHONY'S MOLE.

(Pl. IV, fig. 10; Pl. V, figs. 4, 4a; Pl. VI, fig. 19.)

*Scapanus anthonyi* Allen, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, August 18, 1893.

*Type locality*.—San Pedro Martir Mountains, Lower California; altitude 7000 feet.

*Type specimen*.—No.  $\frac{6313}{4947}$ , Amer. Mus. Nat. Hist.; ♂ adult, skin and skull; collected May 8, 1893, by A. W. Anthony.

*Geographic range*.—Known only from type locality.

*General characters*.—Size, smallest of the genus; feet and hands small; in superficial appearance much like *S. l. occultus*, but smaller and darker; skull smaller than that of *occultus*, flatter, and with relatively shorter rostrum; premolars  $\frac{3}{3}$ .

*Color*.—Type: Upperparts between fuscous and fuscous-black; underparts hair-brown to fuscous.

*Skull*.—Smallest of the genus; in general appearance and proportions similar to that of *S. l. occultus*, but smaller, flatter, and with relatively shorter rostrum; each of the parietals of *occultus* has a small posterior projection, extending between the interparietal and the mastoid, which is not present on the parietals of the type of *anthonyi*; premolars,  $\frac{3}{3}$ .

*Measurements*.—Type (adult male): Total length, 135; tail vertebrae, 26; hind foot (measured by the writer from relaxed foot of dry skin), 17. *Skull*: Type (adult male): Greatest length, 30.1; palatilar length, 12; mastoidal breadth, 16.2; interorbital breadth, 7; maxillary tooth row, 9.3; mandibular molar-premolar row, 9.

*Remarks*.—As previous descriptions of the type and only-known specimen of *anthonyi* have been somewhat inaccurate, particular care has been taken in the present description and measurements. Allen<sup>1</sup> gave the breadth of the interorbital constriction as 7.6 mm., an error probably due to inaccurate measuring instruments. Allen (loc. cit.) claimed that the fourth premolar on one side was wanting and on the other was rudimentary; True<sup>2</sup> in a footnote states that he finds "only three premolars on either side," but elsewhere (loc. cit., p. 51) gives the premolar formula as  $\frac{3}{4}$ . As a matter of fact, the premolar formula is  $\frac{3}{3}$ ; True has correctly indicated this in his sketch (loc. cit., pl. 3, fig. 6) of the mandible. It is not the fourth premolar that is lacking, but either the first or second, probably the first. It seems possible that the dentition of the type is abnormal; however, the reduction of the premolars by one occurs uniformly in each tooth row. It will be impossible to know the exact status of the form until more specimens are available from the region of the type locality. Full specific rank is here given the form because of the absence of evidence showing intergradation with the nearest geographic neighbor, *S. l. occultus*. The type of *anthonyi* is a fully adult male, and if it represents an average specimen of the form, its size and color alone are sufficient characters by which to separate it from *occultus*.

*Specimen examined*.—One, the type.

<sup>1</sup> Allen, J. A., Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, 1893.

<sup>2</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 53, 1896.



## Genus PARASCALOPS True.

*Parascalops* True, Proc. U. S. Nat. Mus., vol. 27, p. 242, April 26, 1894.

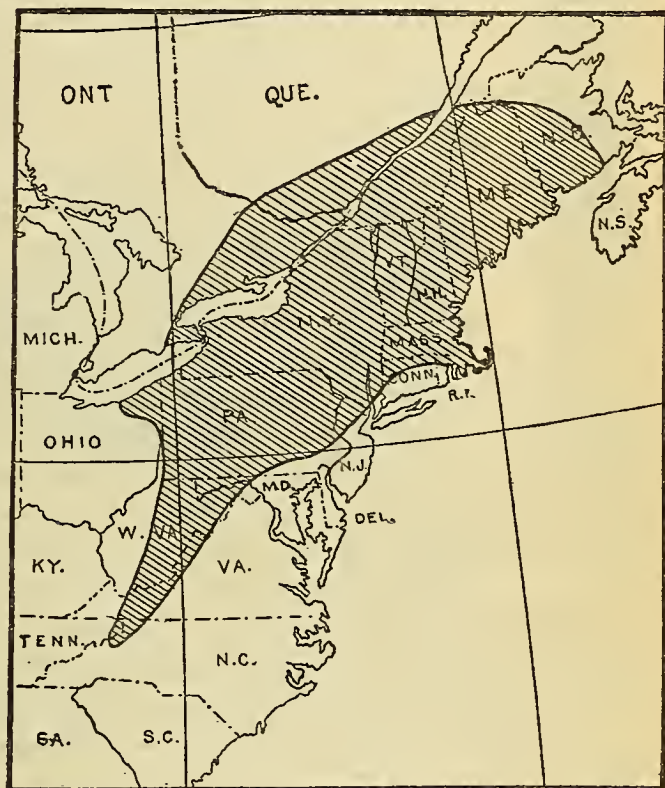
*Perascalops* Beddard, Cambridge Nat. Hist., vol. 10, p. 518, 1902.

*Type species.*—*Scalops breweri* Bachman.

*Geographic range.*—Southeastern Canada and northeastern United States from southern New Brunswick, southern Quebec, and eastern Ontario, south to northeastern Ohio and southern Pennsylvania, and in the Appalachian Mountains to western North Carolina (fig. 13).

*External characters.*—Body robust, not much depressed; tail short (relatively longer than in *Scalopus*), round, thick, and fleshy, slightly

constricted at base, annulated, densely covered with rather long, coarse hairs (fig. 14). Head conoidal, depressed. Nose developed into a conical snout (shorter than in *Scalopus* or *Scapanus*), with a superior longitudinal median groove extending the anterior half of its length; nostrils lateral, crescentic, with concavities upward (fig. 15). Eyes minute, concealed in fur. Auricular orifices relatively large. Legs short. Feet large, fleshy, sparsely



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FIG. 13.—Geographic range of the species *Parascalops breweri*.

haired above, naked below. Fore feet handlike, the palms as broad as long (fig. 16). Soles of hind feet each with two tubercles and a distinct heel-pad (fig. 17). Toes not webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and slender. Fur dense, soft, and silky (coarser than in *Scalopus* or *Scapanus*), the hairs nearly equal in length, producing a velvetlike pelage. Mammæ, 8: latero-pectoral, 2-2; latero-abdominal, 1-1; inguinal, 1-1.

*Skeletal characters.*—Clavicle relatively longer and weaker than in *Scalopus* or *Scapanus*, length about equal to breadth, penetrated antero-posteriorly by a foramen near the inferior border. Humerus

heavy, about two-thirds as broad as long. Pelvis narrow, bones of opposite sides not touching under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra with a small, cuneate, longitudinal process. Os falciforme short, reaching proximal end of first metacarpal; broad and triangular at base, abruptly tapering into a narrow apical process.



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FIG. 14.—Tail of  
*Parascalops breweri* (X1½). No.  
186618, U. S. Nat.  
Mus., Merriam  
collection; from  
Locust Grove,  
N. Y.

Skull conoidal (less so than in *Scalopus*), flat (less so than in *Scalopus* or *Scapanus*), somewhat elongate, with moderately broad braincase, slightly constricted inter-orbitally. Mastoids moderately heavy. Interparietal moderately large (smaller than in *Scapanus*, larger than in *Scalopus*), somewhat rectangular, breadth about one-third the length, emarginate posteriorly and usually anteriorly also, with a posterior median projection. Frontal region depressed; frontal sinuses moderately swollen. Rostrum moderately long; anterior ends of premaxillæ slightly thickened and extending beyond nasals, forming a truncate notch anterior to nasals. Anterior nares opening forward. Zygomata moderately long, relatively heavy, considerably out-curved, the posterior end attached about medially on squamosal. Foramen magnum oval, of moderate size. Infraorbital foramen relatively small (about as in *Scapanus*), the plate forming its outer wall moderately broad (relatively broader than in *Scalopus* or *Scapanus*). Audital bullæ incomplete; no auditory meatus. External pterygoid region moderately inflated (less so than in *Scapanus*) both posteriorly and anteriorly. Mesopterygoid space relatively long and narrow, the sides nearly straight and slightly converging posteriorly. Palate moderately elongate, relatively narrow, terminating opposite posterior edge of last molar; posterior border of

palate emarginate, without spine or notch. Anterior palatine foramina moderate (relatively larger than in *Scapanus*), oval; first pair of posterior palatine foramina moderate, oval to elliptical; second pair, minute or obsolete. Horizontal ramus of mandible moderately heavy, curved upward at posterior end and downward at anterior end; coronoid elongate, quadrate, truncate, directed slightly forward; angle of



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FIG. 15.—Snout of *P. breweri* (X1½). Individual referred to in fig. 14.

palate emarginate, without spine or notch. Anterior palatine foramina moderate (relatively larger than in *Scapanus*), oval; first pair of posterior palatine foramina moderate, oval to elliptical; second pair, minute or obsolete. Horizontal ramus of mandible moderately heavy, curved upward at posterior end and downward at anterior end; coronoid elongate, quadrate, truncate, directed slightly forward; angle of



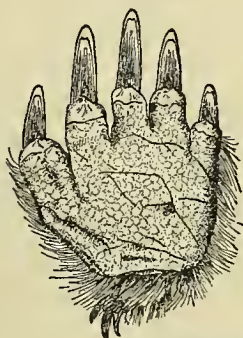
mandible relatively weak (about size of coronoid); inferior mandibular notch broad and shallow.

*Dental characters.*—First upper incisor short, broad, and flat, with a distinct small external accessory cusp; second and third upper incisors, upper canine, and first, second, and third upper premolars simple, conical, of moderate size, subequal (except canine which is larger), about half as high as first incisor; fourth premolar much larger than third, with anterior cusp, and with narrow interior basal ledge slightly bilobed. Upper molars W-shaped in transverse section, with an internal basal shelf distinctly trilobed in first and second premolars and indistinctly bilobed in the third; second molar slightly smaller than first, the third much smaller than second.

First lower incisor small, simple, slightly flattened; second lower incisor larger than first, conical, somewhat canineline; third lower



FIG. 16.—Fore foot of *P. breweri* ( $\times 1\frac{1}{2}$ ). Individual referred to in fig. 14.



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FIG. 17.—Hind foot of *P. breweri* ( $\times 1\frac{1}{2}$ ). Individual referred to in fig. 14.

incisor small (about size of first), conical. Lower canine, and first, second, and third lower premolars essentially similar to third incisor. Fourth premolar about one-third larger than third, the posterior base with a small cusplike shelf or heel. Lower molars M-shaped in transverse section, both antero- and postero-internal cusps bilobed; first and second molars each with a postero-internal basal accessory cusp; second and third molars each with an antero-internal basal accessory cusp; first and second molars subequal, the third much smaller. Dentition: i.  $\frac{3}{3}$ ; c.  $\frac{1}{1}$ ; pm.  $\frac{4}{4}$ ; m.  $\frac{3}{3}$ ; total 44.

#### PARASCALOPS BREWERI (Bachman).

##### HAIRY-TAILED MOLE.

(Pl. IV, fig. 11; Pl. V, figs. 5, 5a; Pl. VI, fig. 20.)

*Talpa Europæa* Harlan (nec *Talpa europæa* Linnæus, 1758), Fauna Amer., p. 43, 1825.

*Talpa americana* Harlan (Bartram ms.) (misidentified with *Talpa europæa* Linnæus, 1758), Fauna Amer., p. 43, 1825.

*Scalops Breweri* Bachman, Boston Journ. Nat. Hist., vol. 4, p. 32, 1842.



[*Scapanus*] *breweri* Pomol, Archiv. Sci. Physiques et Nat., tome 9, p. 247, 1848.

*T[alpa] reposta* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Type locality unknown.

*T[alpa] Breweri* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

*Scapanus americanus* Coues (based erroneously on *Talpa americana* Harlan [Bartram ms.], 1825, qui *Talpa europæa* Linnæus, 1758), Amer. Nat., vol. 13, p. 190, 1879.

*Scaphanus* (sic) *breweri* Herrick, Geol. & Nat. Hist. Surv. Minnesota, Bul. 7, p. 55, 1892.

*Parascalops breweri* True, Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

*Type locality*.—Marthas Vineyard, Massachusetts.

*Type specimen*.—None known to exist.

*Geographic range*.—That of the genus (see p. 77).

*General characters*.—Size medium (length averaging about 155 mm.); nostrils lateral, crescentic, with concavity upward; tail short, thick, densely covered with hair; color dark; usually fuscous-black or chætura black; skull flat; audital bullæ incomplete; rostrum slender; first upper incisors with a distinct external accessory cusp.

*Color*.—General tone, fuscous-black, chætura black, or chætura drab, slightly paler and more grayish on underparts; hairs on feet, and usually on nose and tail, more brownish, often becoming white in old adults; throat and underparts sometimes stained with Dresden brown or Saccardo's umber. The color in study skins soon fades and becomes slightly brownish.

*Skull*.—Size medium (length about 32 mm.), flat, depressed post-orbitally, especially in adults, slightly constricted interorbitally; zygomata moderately heavy; pterygoids small; audital bullæ incomplete; auditory meatus absent; rostrum narrow; dentition moderate; first upper incisor with distinct outer secondary cusp; internal edge of second upper molar trilobed.

*Measurements*.—Average of 8 adult males from Magnetic City, N. C.: Total length, 149.5 (139–152); tail vertebræ, 30 (23–36); hind foot, 19.5 (18–20). Average of 2 adult females from Lunenburg, Mass.: 153 (153–153); 29.5 (27–32); 18.5 (18–19). *Skull*: Average of 10 skulls of adult males from Magnetic City, N. C.: Greatest length, 32.4 (31–33.8); palatilar length, 12.6 (12.1–13.1); mastoidal breadth, 14.5 (13.9–15); interorbital breadth, 7.3 (7.1–7.5); maxillary tooth row, 9.9 (9.2–10.2); mandibular molar-premolar row, 9.5 (8.9–9.8). Skull of adult female from Lunenburg, Mass.: Greatest length, 31.2; palatilar length, 12.2; mastoidal breadth, 14.3; interorbital breadth, 7.2; maxillary tooth row, 9.6; mandibular molar-premolar row, 9.3.

*Remarks*.—Bartram was apparently the first to recognize this form, to which he gave the manuscript name *Talpa americana*. Harlan<sup>1</sup> placed *Talpa americana* (Bartram ms.) in synonymy under *Talpa europæa* Linnæus, apparently failing to distinguish the two forms

<sup>1</sup> Harlan, R., Fauna Amer., p. 43, 1825.

even with the Bartram manuscript in hand. Bachman<sup>1</sup> described the species in 1842 under the name *Scalops breweri*, basing his description upon a specimen "found by Dr. L. M. Yale, at Martha's Vineyard, an Island on the coast of New England." Coues,<sup>2</sup> however, in 1879 applied the name *Scapanus americanus* to this species on the ground that Harlan's description was "applicable neither to *Scalops* [= *Scalopus*] nor to *Talpa*" and that "he [i. e. Harlan] really had in view an American mole, which he recognized as distinct, both generically and specifically, from our common *Scalops aquaticus*." The name *Talpa americana* Harlan (Bartram ms.), however, is untenable for several reasons: Harlan placed it in synonymy under *Talpa europæa* Linnæus (loc. cit.); Harlan actually misidentified the American animal with *Talpa europæa* Linnæus, as is evident from his mentioning in his introduction a species of mole as common to both continents,<sup>3</sup> and, by process of eliminating those species which he distinctly refers in his descriptions to an American distribution, it becomes evident that the animal he meant was *Talpa europæa* Linnæus; furthermore, Harlan's description, as has been shown by True,<sup>4</sup> is a translation, word for word (with a very few omissions) of Desmarest's<sup>5</sup> description of *Talpa europæa* Linnæus.

The description of *Talpa reposta* Le Conte is based upon a specimen from an unknown locality and seems to refer to a specimen of *Parascalops breweri* with slightly abnormal teeth.

The hairy-tailed mole shows remarkably little geographic variation, and such as does occur is obliterated by individual variation. This variation is manifest mostly in size, and, in adults, size variation may reach about 5 per cent below or above the average at a given locality. White spots and blotches on the ventral parts of a few specimens of young, as well as of adults, indicate an occasional tendency toward partial albinism. In extreme old age the skull flattens and becomes much depressed postorbitally. A most peculiar change associated with old age is that, in many specimens examined, the hair on the nose and tail is white; in other specimens, somewhat younger but distinctly adult, some of the hairs on the nose and tail are normally colored, others are white. This peculiar senile variation is not confined to any particular region, but seems to be more prevalent north of Pennsylvania.

The hairy-tailed mole is rather rare and local in distribution, and difficult to trap. It is, therefore, quite probable that in the course of time its known geographic range may be extended considerably.

<sup>1</sup> Bachman, J., Boston Journ. Nat. Hist., vol. 4, p. 32, 1842.

<sup>2</sup> Coues, E., Amer. Nat., vol. 13, pp. 189-190, 1879.

<sup>3</sup> Harlan, R., Fauna Amer., p. viii, 1825.

<sup>4</sup> True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 76, 1896.

<sup>5</sup> Desmarest, A. G., Mammalogie, 1<sup>re</sup> partie, p. 160, 1820.

Bachman<sup>1</sup> lists it from Georgia but does not mention any specimen or definite locality. The writer has seen only three specimens from Canada: One from Quebec, Quebec, is in the United States National Museum; another, a flat skin without skull, was collected at Meaches Lake, Quebec, and is in the Victoria Memorial Museum at Ottawa; the third is a skeleton collected at Saint Catharines, Ontario, and is in the exhibition cases of the United States National Museum. Chamberlain<sup>2</sup> records seeing a specimen from Charlotte County, New Brunswick. Specimens have been collected in Ontario, "near Ottawa,"<sup>3</sup> and at Guelph<sup>4</sup> and Acton.<sup>5</sup> Nash<sup>6</sup> records specimens from several counties in Ontario, but mentions no specific localities.

*Specimens examined.*—Total number, 129, as follows:

Connecticut: West Winsted, 1.

Maine: Lake Umbagog, 1.

Massachusetts: Harvard, 1;<sup>7</sup> Lunenburg, 3.

New Hampshire: Dublin, 1; Ossipee, 1; Webster, 2.<sup>8</sup>

New York: Elizabethtown, 1;<sup>8</sup> Lake George, 7; Lansing, 3;<sup>9, 10</sup> Locust Grove, 16; Oswego, 1;<sup>10</sup> Plateau Mountain, Catskills, 1; Peterboro, 3; Waterville, 1.

North Carolina: Magnetic City, foot of Roan Mountain, 31; Roan Mountain (altitude 3000 feet), 1.

Ohio: Cleveland, 1; Ellsworth, 2; Ravenna, 3.<sup>10</sup>

Ontario: St. Catharines, 1.

Pennsylvania: Allegheny County, 1; Brownsburg, 1;<sup>11</sup> Carnot, 1;<sup>12</sup> Erie, 1;<sup>10</sup> Leasuresville, 9; New Lexington, 1;<sup>12</sup> Ohiopyle, 1;<sup>12</sup> Pittsburgh, 4;<sup>12</sup> Warren, 1.<sup>12</sup>

Quebec: Meaches Lake, Wright County, 1;<sup>13</sup> Quebec, 1.

Vermont: East Wallingford, 5.<sup>14</sup>

Virginia: Mountain Lake, 1; Mount Rogers, 1.

West Virginia: Cranberry Glades, 1; Franklin, 1; Traveller's Repose, 1; Wetzel County, 1; White Sulphur Springs, 15.<sup>8, 9, 10, 11</sup>

#### Genus *CONDYLURA* Illiger.

*Condylura* Illiger, Prod. Syst. Mamm. et Avium, p. 125, 1811.

*Talpasorex* Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. Nec *Talpasorex* Lesson, 1827.

*Astromycter* Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]).

*Rhinaster* Wagler, Nat. Syst. Amphib., p. 14, 1830.

*Condytura* Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 994, 1839.

<sup>1</sup> In White, G., Statistics of the State of Georgia, Fauna and Flora, p. 4, 1849.

<sup>2</sup> Chamberlain, M., Bul. Nat. Hist. Soc. New Brunswick, no. 3, p. 39, 1884.

<sup>3</sup> Whiteaves, J. F., Ann. Rept. Dept. Interior Canada for 1888, part 3 (Geol. Surv.), p. 36, 1889.

<sup>4</sup> Goldie, A., Ontario Nat. Sci. Bul., No. 3, p. 40, 1907.

<sup>5</sup> Moore, T. J., Ontario Nat. Sci. Bul., No. 3, p. 41, 1907.

<sup>6</sup> Nash, C. W., Check List of Vertebrates of Ontario, p. 26, 1906.

<sup>7</sup> Collection of Hartley H. T. Jackson.

<sup>8</sup> Collection Mus. Comp. Zool., Harvard College.

<sup>9</sup> Collection Field Mus. Nat. Hist.

<sup>10</sup> Collection Amer. Mus. Nat. Hist.

<sup>11</sup> Collection Acad. Nat. Sci. Philadelphia.

<sup>12</sup> Collection Carnegie Mus.

<sup>13</sup> Collection Victoria Mem. Mus.

<sup>14</sup> Collection of D. E. Kent, Rutland, Vermont.



*Astromyctes* Gray, List Spec. Mamm. Brit. Mus., p. 76, 1843.

*Astromydes* Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863.

*Condylus* Van Hyning, Science, n. s., vol. 38, p. 243, August 15, 1913.

*Type species.*—*Sorex cristatus* Linnæus.

*Geographic range.*—Southeastern Canada and northeastern United States, from southern Labrador, central Quebec and Ontario, and



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FIG. 18.—Geographic range of the species *Condylura cristata*.

southeastern Manitoba, south to northeastern Illinois and northern Indiana and Ohio; in the Atlantic coast region south to Virginia (Dismal Swamp) and Georgia (Marlow); and in the Appalachian Mountains to western North Carolina (fig. 18).

*External characters.*—Body semirobust, not much depressed. Tail relatively long (about equal in length to body without head),

distinctly annulated, scaled, and covered with coarse blackish hairs; in summer the tail is slender, slightly depressed, gradually tapering apically, and slightly constricted proximally; in winter it is greatly enlarged, thick and fleshy, gradually tapering apically, and abruptly



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FIG. 19.—Tail of *Condylura cristata* (X 1½). Autumnal enlargement scarcely begun. No. 144473, U. S. Nat. Mus.; from Egelston township, Muskegon County, Mich., August 20, 1906.

much constricted at the base (fig. 19). Head narrow, not much depressed. Snout moderately elongate, terminating in a naked disk surrounded on its margin by a fringe of twenty-two nasal processes symmetrically arranged, cloven on each side of a median line (fig. 20). Nostrils nearly circular, situated in anterior surface of nasal disk. Eyes small (relatively large for Talpidæ; larger than in *Scalopus*, *Scapanus*, or *Parascalops*), concealed in fur. Auricular orifice large. Legs short; weaker than in *Scalopus*, *Scapanus*, or *Parascalops*. Feet large, not especially fleshy, scaled, scarcely haired above, naked below. Fore feet handlike, the palms as broad as long; toes relatively long; first, second, third, and fourth toes each with three flat, triangular processes on outer inferior edge, the basal process on the first toe being small and inconspicuous. Fore claws relatively long, broad (but narrower than in *Scalopus*, *Scapanus*, or *Parascalops*), depressed, the superior surface turned obliquely outward (fig. 21). Hind feet relatively long and narrow, broader apically than basally; a large depressed triangular plantar tubercle lies near the base of the first digit, and distally and inwardly on the sole are five small tubercles. Hind claws relatively long, laterally compressed, the outer surface turned obliquely upward (fig. 22). Toes not webbed. Fur dense, long, and silky (relatively coarser than in *Scalopus*, *Scapanus*, or *Parascalops*); some of the hairs longer and coarser than the major portion, which forms a distinct underfur. Mammæ, 8: latero-pectoral, 2-2; latero-abdominal, 1-1; inguinal, 1-1.

*Skeletal characters.*—Clavicle relatively long and narrow (for Talpidæ), length about twice the breadth, slightly concave superiorly and convex inferiorly, not penetrated by a foramen. Humerus about two-thirds as broad as long, much weaker medially than in *Parascalops*. Pelvis narrow, bones of opposite sides not touching under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra with a distinct, flat, deltoid, longitudinal process. Os falciforme small but distinct, short, reaching proximal end of first metacarpal; moderately broad, not much tapering distally.

Skull long and narrow, not much flattened, with relatively high and narrow braincase, not constricted interorbitally, tapering



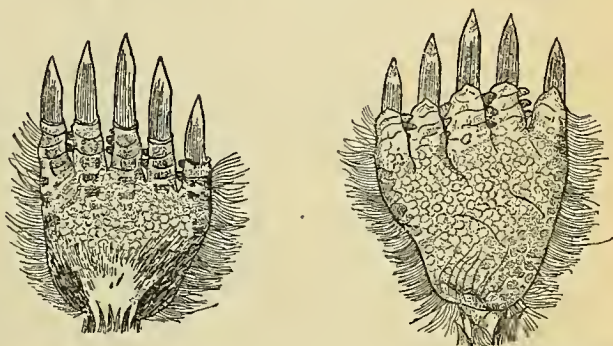
distally. Mastoids weak. Interparietal large, broad, irregularly crescentic, anteriorly deeply emarginate medially, posteriorly broadly



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FIG. 20.—Snout of *C. cristata* ( $\times 1\frac{1}{2}$ ). Individual referred to in fig. 19.

emarginate with a posterior median projection. Frontal region sloping ventrally anteriorly; frontal sinuses scarcely swollen. Rostrum long and narrow, in adults with a distinct basal supero-median crest; infero-anterior ends of premaxillæ extending much beyond nasals; supero-anterior ends of premaxillæ barely reaching beyond nasals; nasals in adults terminating anteriorly in an acute median point.



B2027-103

FIG. 21.—Fore foot of *C. cristata* ( $\times 1\frac{1}{2}$ ). Individual referred to in fig. 19.

Anterior nares opening obliquely upward. Zygomata short, narrow, straight, directed obliquely downward anteriorly, the posterior end



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FIG. 22.—Hind foot of *C. cristata* ( $\times 1\frac{1}{2}$ ). Individual referred to in fig. 19.

well forward on squamosal. Foramen magnum elliptical, large. Infraorbital foramen very large, the plate forming its outer wall relatively very narrow. Audital bullæ incomplete; no auditory meatus. External pterygoid region scarcely inflated. Mesopterygoid space long and broad, the sides converging posteriorly (pterygoids, however, slightly diverging). Palate elongate, very narrow, terminating opposite anterior border of last molar; posterior border of palate deeply emarginate, frequently with a median spine. Anterior palatine foramina minute; posterior palatine foramina very large and conspicuous,



the first pair <sup>1</sup> reniform or elliptical-oval and about twice as large as the second pair which are usually elliptical. Horizontal ramus of mandible weak, curved upward posteriorly, straight anteriorly; coronoid moderately long, somewhat broad, but relatively weak, erect, slightly acute; angle of mandible very long and slender (much longer and narrower than coronoid), the inferior edge turned inward; inferior mandibular notch large and angular.

*Dental characters.*—First upper incisor large, semiovate, curved inward and directed anteriorly; second upper incisor linear, minute, lying close under base of first incisor; third upper incisor lateral, large, elongate, caninelike, with a small postero-basal tubercle disappearing with age. Upper canine short and slender (less than half dimensions of third incisor), conical. First, second, and third upper premolars small, laterally compressed, successively increasing in size posteriorly, each with an anterior and a posterior basal tubercle; fourth upper premolar similar to third, much larger, with an interior basal cusplike process. Upper molars W-shaped in transverse section, with an interior basal shelf having an indistinctly tricuspidate edge; first and second molars nearly subequal, the third much smaller.

First lower incisor moderate in size, spatulate, flat, directed anteriorly; second incisor close and superior to first, similar in shape, much smaller (about half as large), directed anteriorly; third upper incisor minute, slightly flattened apically, curved downward, directed anteriorly. Lower canine long, slender, curved posteriorly, with a rather large posterior basal accessory cusp and a very small anterior one. Lower premolars small (successively slightly increasing in size posteriorly), compressed laterally, each with a well-developed posterior cusplike heel and a small cusplike development (minute in the first premolar) of anterior portion of cingulum. Lower molars M-shaped in transverse section, laterally compressed; interior shelf narrow, tricuspidate, the median cusp indistinctly bifid; first and third molars subequal, the second slightly larger. Dentition: i.  $\frac{3}{2}$ ; c.  $\frac{1}{1}$ ; pm.  $\frac{4}{4}$ ; m.  $\frac{3}{3}$ ; total 44.

#### CONDYLURA CRISTATA (Linnæus).

##### STAR-NOSED MOLE.

(Pl. IV, fig. 12; Pl. V, figs. 6, 6a; Pl. VI, fig. 21.)

*Sorex cristatus* Linnæus, Syst. Nat., ed. 10, vol. 1, p. 53, 1758.

*Talpa longicaudata* Erxleben, Reg. Anim., p. 118, 1777. Based on Pennant's long-tailed mole; type locality, North America.

*Talpa Cristata* Zimmermann, Specimen Zool. Geog., p. 496, 1777.

<sup>1</sup> It may be that these large palatine vacuities are not functional foramina. They have the position, however, of the first pair of posterior palatine foramina, and, whatever their function, they are of considerable generic diagnostic importance.

- Talpa Caudata* Zimmermann (nec *Talpa caudata* of Linnæus and others), Specimen Zool. Geog., p. 497, 1777. Based on Pennant's long-tailed mole; type locality, North America.
- ?*Talpa canadensis* De La Faille, Naturgesch. des Maulwurtes, t. 1, p. 3, 1778. [Not seen.]
- Talpa radiata* Shaw, Gen. Zool., Mamm., vol. 1, p. 523, 1800. New name for *Sorex cristatus* Linnæus.
- Sorex radiatus* Shaw, Gen. Zool., Mamm., vol. 1, p. 531, 1800. Based upon a figure and description of De La Faille. Type locality, Canada.
- Scalopus cristatus* Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.
- Scalops cristatus* Fischer, Zoognosia, vol. 3, p. 156, 1814.
- Condylura cristata* Desmarest, Journ. de Physique, de Chimie, d'Hist. Nat. et des Arts, vol. 89, p. 230, September 1819.
- Condylura longicaudata* Desmarest, Journ. de Physique, de Chimie, d'Hist. Nat. et des Arts, vol. 89, p. 232, September, 1819.
- Tal[pasorex] cristata* Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821.
- Condylura fissipes* Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)
- Talpa flava* Schinz (nec *Talpa flava* Zimmermann), Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)
- [*Talpa*] *purpurascens* Schinz (nec *Talpa purpurascens* Shaw qui *Talpa europæa* Linnæus), Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)
- Condylura macroura* Harlan, Fauna Amer., p. 39, 1825. Type locality, New Jersey.
- Astromycter prasinatus* Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]). Type locality, Maine.
- Condylura prasinata* Harris, Boston Journ. Philos. and Arts, vol. 2, p. 582, July, 1825.
- Talpasor[ex] longicaudata* Schinz, Cuvier's Thierreich, vol. 4, p. 312, 1825.
- ?*Talpasorex fissipes* Minding, Geog. Vertheilung der Säugethiere, p. 64, 1829. (Nomen nudum.)
- astromycter prarinatus* (sic) Rafinesque, Atlantic Journ. and Friend of Knowledge, vol. 1, p. 61, Summer 1832.
- Condylura cristata* Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 996, 1839.
- Rh[inaster] cristatus* Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 114, 1841.
- Rh[inaster] macrurus* Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 115, 1841.
- Rh[inaster] longicaudatus* Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 115, 1841.
- Rh[inaster] macroura* Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 117, 1841.
- Talpa (Condylurus) cristata* Blainville, Osteographie, Atlas 1, tables des planches, p. 4; fasc. 6, Insectivores, pl. 1 (skeleton), pl. 5 (skull), pl. 9 (teeth), 1839-1864.
- Astromydes* (sic) *cristatus* Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863.
- Condylus* (sic) *cristata* Van Hynning, Science, n. s., vol. 38, p. 243, August 15, 1913.

*Type locality*.—Eastern Pennsylvania.

*Geographic range*.—That of the genus (see p. 83).

*General characters*.—Size medium; color dark, blackish; tail long, about equal in length to body (without head), in autumn and winter much enlarged, slightly shortened, but constricted at base, scaly, haired; nostrils anterior, in nasal disk surrounded by twenty-two fleshy processes; skull relatively long and narrow; audital bullæ incomplete; premaxillæ much extended beyond nasals anteriorly; first upper incisors large, incurved, and projecting anteriorly.

*Color*.—*Fresh pelage*: Upperparts blackish brown to nearly black; underparts paler and more brownish, fuscous to fuscous-black; tail



similar to back, sometimes indistinctly bicolored. *Worn pelage:* Paler and more brownish than fresh pelage; upperparts fuscous to fuscous-black; underparts fuscous to hair-brown; wrists frequently with a narrow ring varying from pinkish buff to clay color. Nasal disk and processes in live animals rose color. Young usually paler and more brownish than adults.

*Skull.*—Size medium (length about 34 mm.), elongate, narrow (breadth across mastoids about 13 mm.), not depressed postorbitally; braincase moderately high and arched; interparietal wide anteroposteriorly; audital bullæ incomplete; premaxillæ much extended beyond nasals anteriorly; adults with distinct crest between posterior halves of nasals; zygomata short, narrow, straight, directed obliquely downward anteriorly; palate narrow; dentition weak; first upper incisor broad, incurved, projecting anteriorly; second upper incisor minute; third upper incisor long, narrow, caninelike, in young with a small postero-lateral basal tubercle; upper molars with indistinctly trilobed inner basal ledge.

*Measurements.*—Average of 10 adult males from Digby, Nova Scotia: Total length, 202.2 (189–211); tail vertebræ (summer), 78.4 (71–83.5); hind foot, 28.1 (26–30). Average of 2 adult males from Washington, D. C.: Total length, 184 (183–185); tail vertebræ (winter), 65.5 (65–66); hind foot, 28 (28–28). *Skull:* Adult (male ?) from Holmesburg, Pa.: Greatest length, 34.1; palatilar length, 12.9; mastoidal breadth, 13.1; interorbital breadth, 7; maxillary tooth row, 11; mandibular molar-premolar row, 11.3. Average of 3 skulls of adult males from Locust Grove, N. Y.: Greatest length, 34.6 (34.1–35.2); palatilar length, 13.2 (13–13.3); mastoidal breadth, 13.6 (13.5–13.7); interorbital breadth, 7.2 (7.1–7.2); maxillary tooth row, 11.5 (11.4–11.5); mandibular molar-premolar row, 11.6 (11.5–11.7). Skull of adult female from Locust Grove, N. Y.: Greatest length, 35; palatilar length, 13.3; mastoidal breadth, 13.4; interorbital breadth, 7.3; maxillary tooth row, 11.5; mandibular molar-premolar row, 11.9. Average of 10 skulls of adult males from Digby, Nova Scotia: Greatest length, 33.9 (33.1–35); palatilar length, 13 (12.9–13.6); mastoidal breadth, 13.4 (13–14); interorbital breadth, 7.2 (7–7.4); maxillary tooth row, 11.1 (10.6–11.5); mandibular molar-premolar row, 11.3 (11–11.9). Average of 2 skulls of adult males from Washington, D. C.: Greatest length, 33.8 (33.6–33.9); palatilar length, 13.1 (12.7–13.5); mastoidal breadth, 12.7 (12.6–12.8); interorbital breadth, 6.8 (6.7–6.8); maxillary tooth row, 11.2 (11.1–11.2); mandibular molar-premolar row, 11.2 (11.1–11.3).

*Remarks.*—Linnæus's description, in 1758, of the star-nosed mole under the name *Sorex cristatus*, appears to be its first mention in literature; on the authority of Kalm, Pennsylvania is given as its



habitat. Pennant,<sup>1</sup> in 1771, described two moles under the names "Radiated Mole" and "Long-tailed Mole"; the former he correctly considered to be the *Sorex cristatus* of Linnæus; his long-tailed species must also be referred to *Condylura cristata* since he describes it as a mole with a radiated nose and a tail two inches long, a description which applies to no other mammal. Pennant's description of the long-tailed mole was probably based upon either a young or a summer specimen in which the diameter of the tail was minimum; as early as 1777 this became the basis for two Latin binomials, *Talpa caudata* Zimmermann<sup>2</sup> and *Talpa longicaudata* Erxleben.<sup>3</sup> The writer has been unable to verify the name *Talpa canadensis* of De La Faille. Shaw<sup>4</sup> renamed *Sorex cristatus* Linnæus, calling it *Talpa radiata*; he also recognized *Talpa longicaudata*, but in his remarks under *Talpa radiata* states: "It is, perhaps, in reality no other than a variety of the former species (i. e. *T. longicaudata*), or a sexual difference."<sup>5</sup> Shaw<sup>6</sup> again renamed the species when he confused a figure and description of it, given by De La Faille, with the genus *Sorex*, and called it *Sorex radiatus*. That Shaw should thus have been misled is strange, since he writes:

One would be inclined to think that the remarkable moniliform appearance of the tail in this animal, as exhibited in M. de la Faille's figure, may be partly owing to the contraction of the interstices of the joints in drying.

It is evidently allied to the radiated Mole, but if the figure given by M. de la Faille be accurate, must surely be a very distinct species.<sup>7</sup>

Schinz,<sup>8</sup> when substituting the generic name *Talpasorex* for *Condylura*, used the name *Condylura fissipes* in synonymy under *Talpasorex cristatus*; it seems probable that the name *fissipes* had been used in literature previous to this, but the present writer has been unable to find an earlier usage. Schinz (loc. cit.) also placed the names *Talpa flava* and *Talpa purpurascens* in synonymy under *Talpasorex cristatus*; this was probably purely an error on his part, since there is nothing in the original descriptions of *Talpa flava* Zimmermann and *Talpa purpurascens* Shaw, nor in subsequent descriptions of these forms, which would lead one to confuse either with *Condylura* Illiger; the former name is a synonym of *Scalopus a. aquaticus* (Linnæus), the latter of *Talpa europæa* Linnæus. In 1825, two other names were proposed which apply to the star-nosed mole—

<sup>1</sup> Pennant, T., Quadrupeds, 1771. The present writer has not seen this work but presumes the descriptions are essentially the same as those in Pennant's History of Quadrupeds, ed. 3, vol. 2, p. 232, pl. 90, 1793.

<sup>2</sup> Zimmermann, E. A. W., Spec. Zool. Geog., p. 497, 1777.

<sup>3</sup> Erxleben, J. C. P., Syst. Reg. Anim., p. 118, 1777.

<sup>4</sup> Shaw, George, Gen. Zool., Mamm., vol. 1, p. 523, 1800.

<sup>5</sup> Shaw, loc. cit., p. 524.

<sup>6</sup> Shaw, loc. cit., p. 531.

<sup>7</sup> Shaw, loc. cit., p. 532.

<sup>8</sup> Schinz, H. R., Cuvier's Thierreich, vol. 1, p. 191, 1821.

*Condylura macroura* Harlan<sup>1</sup> and *Astromycter prasinatus* Harris.<sup>2</sup> Both Harlan and Harris based their descriptions upon animals whose tails were in the enlarged winter condition. Harris was further deceived by his specimen being discolored with a shade of green, and proposed the new genus *Astromycter* to include this animal, though later<sup>3</sup> he returned it to the genus *Condylura*.

It is to be remarked that *Condylura cristata* has comparatively little geographic variation over a wide zonal range; specimens from the Lower Austral Zone, in Georgia and Virginia, are subspecifically inseparable from those from the Boreal Zone in Quebec and Labrador. A very slight increase in size is noticeable toward the northern part of the range of the species, but it is inconstant, and insufficient for subspecific recognition. Occasional local variations appear, but when a large series is examined from any one locality these prove inconstant, or else crop out in remote localities. Thus, in a series from Digby, Nova Scotia, the skulls have on the average very slightly higher braincases and more abruptly sloping frontals, but the difference is not constant and can be matched perfectly by specimens from New York, Massachusetts, Pennsylvania, and Maryland; the same is true of a small postpalatal process present in the majority of skulls in the series from Digby. A specimen from Marlow, Georgia, is an alcoholic from which the broken and imperfect skull has been removed for study; it offers no characters by which it can be separated from typical specimens from Pennsylvania. Possibly when larger series of adult specimens are available differences of diagnostic value not now discernible will become apparent.

The limits of the geographic range of *Condylura* are not satisfactorily known. Many published records of the star-nosed mole have certainly been based upon erroneous identifications. For example, the species is included among the mammals supposed to occur in Oklahoma,<sup>4</sup> and Townsend<sup>5</sup> lists it from "the Territory of the Oregon."

Richardson<sup>6</sup> describes a specimen said to have been taken by Douglas on the "banks of the Columbia." Richardson's description clearly indicates that the animal he had in hand was *Condylura cristata*, but it is almost certain that it was not collected near the banks of the Columbia River. The most westerly known point of the range of the species is in Manitoba, where, according to Seton,<sup>7</sup>

<sup>1</sup> Harlan, R., Fauna Amer., p. 39, 1825.

<sup>2</sup> Harris, T. W., Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825.

<sup>3</sup> Harris, T. W., Boston Journ. Philos. and Arts, vol. 2, p. 582, July, 1825.

<sup>4</sup> Woodhouse, S. W., Report of an Expedition Down the Zuni and Colorado Rivers, by Capt. L. Sitgreaves; Mammals, p. 43, 1854.

<sup>5</sup> Under the names *Condylura longicaudata* and *Condylura macroura*. Townsend, J. K., Narrative of Journey across the Rocky Mountains to the Columbia River, p. 313, 1839.

<sup>6</sup> Under the name *Condylura macroura*. Richardson, J., Fauna Boreali-Amor., vol. 1, p. 284, 1829.

<sup>7</sup> Seton, Ernest Thompson, Life-Histories of Northern Animals, vol. 2, p. 1137, 1909.



specimens have been brought to the taxidermist shop of W. R. Hine in Winnipeg. Cory<sup>1</sup> records a specimen from Warsaw, Ill., and Professor Frank Smith, of the University of Illinois, found a dead specimen in the vicinity of Urbana in the same State.<sup>2</sup>

*Specimens examined.*—Total number 218, as follows:

**Connecticut:** East Hartford, 1; Liberty Hill, 1;<sup>3</sup> Norfolk, 1.

**District of Columbia:** Washington, 10.

**Georgia:** Marlow, 1.

**Labrador:** Black Bay, 1;<sup>3</sup> Hamilton Inlet, 2; Paradise, 2; Saint Michael Bay, 1; Sandwich Bay, 2.

**Maine:** Eastport, 1; Freeport, 1; Oakland, 1; Penobscot River (East Branch), 2; Small Point, 2.

**Maryland:** Brookeville, 1; Cabin John, 1; Chevy Chase, 1; College Park, 2; Glendale, 1; Laurel, 2; Marshall Hall, 1; Prince Georges County, 1; Williamsport, 1; Woodside, 2.

**Massachusetts:** Belmont, 4;<sup>3</sup> Gardner, 1; Lunenburg, 4; Medway, 1;<sup>3</sup> Middleboro, 2; New Bedford, 1; Newburyport, 2; Seehonk, 1;<sup>4</sup> Watertown, 2;<sup>3</sup> Williamstown, 1; Wilmington, 4.

**Michigan:** Ann Arbor, 8;<sup>5</sup> Chelsea, 1;<sup>5</sup> Douglas Lake, 1;<sup>5</sup> Geddes, 1;<sup>5</sup> Gogebic, 1;<sup>6</sup> Hancock, 1;<sup>5</sup> Kalamazoo County, 1;<sup>5</sup> Muskegon County, 1; Porcupine Mountains, 2;<sup>5</sup> Portage Lake, 6.<sup>5</sup>

**Minnesota:** Elk River, 1; Fort Ripley, 1; Margie, 1.

**New Brunswick:** Arthurette, 1;<sup>7</sup> Hampton, 1.

**New Hampshire:** Ossipee, 4; Webster.<sup>3</sup>

**New Jersey:** Lake Hopatcong, 5;<sup>4</sup> Tuckahoe, 1.<sup>4</sup>

**New York:** Cross River, 1; Essex County, 1; Geneva, 2; Highland Falls, 2;<sup>7</sup> Ithaca, 1;<sup>8</sup> Lake George, 2; Lansing, 2;<sup>6,9</sup> Lockport, 1; Locust Grove, 11; Lyons Falls, 1; New York, 2; Nichols, 1; Oswego, 1;<sup>9</sup> Pelham, 1; Peterboro, 5; Rockland, 1;<sup>7</sup> Saint Lawrence County, 1; Sing Sing, 3.

**North Carolina:** Magnetic City, 2; Weaverville, 1.<sup>3</sup>

**Nova Scotia:** Barrington Passage, 1;<sup>10</sup> Digby, 18; Halifax, 7; James River, 1;<sup>3</sup> Newport, 2.<sup>7</sup>

**Ohio:** Cleveland, 1; Ellsworth, 1; Garrettsville, 3.

**Ontario:** Landsowne, 1;<sup>7</sup> Middlesex County, 1;<sup>10</sup> Moose Factory, 1; Muskoka, 1;<sup>7</sup> Ottawa, 4.

**Pennsylvania:** Carlisle, 1; Lake Leigh, 1;<sup>4</sup> Meadville, 2; New Lexington, 2;<sup>4,11</sup> Philadelphia, 1;<sup>4</sup> Radnor, 1.<sup>4</sup>

**Quebec:** East Main River, 1;<sup>11</sup> Godbout, 3; Lake Edward, 1;<sup>3</sup> Montreal, 1.

**Vermont:** East Wallingford, 4;<sup>12</sup> Mount Mansfield, 2; Rutland, 1.<sup>13</sup>

**Virginia:** Dismal Swamp, 4.

**Wisconsin:** Colby, 1; Medford, 2;<sup>6</sup> Merrill, 1;<sup>6</sup> Newald, Forest County, 1.<sup>6</sup>

<sup>1</sup> Cory, C. B., Field Mus. Nat. Hist., publ. 153, zool. series 11, p. 444, 1912. In a personal letter dated March 20, 1914, Mr. Cory writes in regard to this specimen: "On a number of occasions Mr. Charles K. Worthen sent me boxes of birds and mammals, from which I could select specimens I desired and send back the others. One lot contained a specimen of *Condylura cristata* simply labeled 'Warsaw' (in pencil) with no other data. The specimen was returned to him."

<sup>2</sup> Wood, F. E., Bul. Illinois State Lab. Nat. Hist., vol. 8, p. 588, 1910.

<sup>3</sup> Collection Mus. Comp. Zool., Harvard College.

<sup>4</sup> Collection Acad. Nat. Sci. Philadelphia.

<sup>5</sup> Collection Univ. Michigan Mus.

<sup>6</sup> Collection Milwaukee Public Mus.

<sup>7</sup> Collection Amer. Mus. Nat. Hist.

<sup>8</sup> Collection of Hartley H. T. Jackson.

<sup>9</sup> Collection Field Mus. Nat. Hist.

<sup>10</sup> Collection Victoria Mem. Mus.

<sup>11</sup> Collection Carnegie Mus.

<sup>12</sup> Collection of D. E. Kent, Rutland, Vt.

<sup>13</sup> Collection of G. L. Kirk, Rutland, Vt.



## Genus NEÜROTRICHUS Günther.

*Neürotrichus* Günther, Proc. Zool. Soc. London, 1880, p. 441, October, 1880.

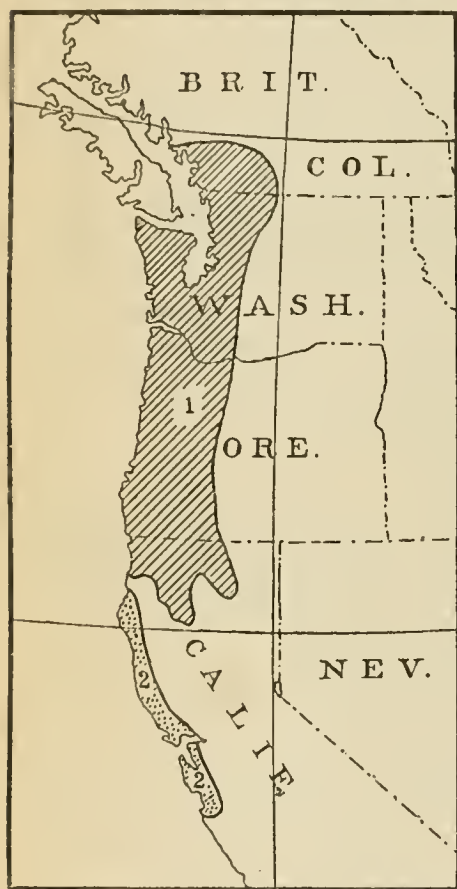
*Neürotrichus* Günther, Proc. Zool. Soc. London, 1880, plate 42, October, 1880.

*Neurotrichus* Forbes, Zool. Record, vol. 17, Mammalia, p. 14, 1881.

*Neurotrichus* Rye, Zool. Record, vol. 17, Index, p. 8, 1881.

*Type species.*—*Urotrichus gibbsii* Baird.

*Geographic range.*—Pacific coast region of North America west of the Cascades and Sierra Nevada, from southwestern British Columbia (Fraser River region) south to Fremont Peak, Monterey County, California (fig. 23).



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FIG. 23.—Geographic range of the subspecies of *Neürotrichus gibbsii*. 1. *N. g. gibbsii*. 2. *N. g. hyacinthinus*.

Feet large, not fleshy, scaled, sparsely haired above, naked below. Fore feet hardly handlike, the palms longer than broad, toes relatively long. Fore claws relatively long, not broad, not depressed (fig. 26). Hind feet long and narrow, broader distally than proximally; six tubercles (varying slightly in position) on each hind foot, usually located one at base of third digit, one interdigital between the third and fourth digits, one between the fourth and fifth digits, one postero-interdigital between the second and third digits, and two near the center of the sole. Hind claws moderately long and slender, slightly compressed laterally, acute (fig. 27). Toes not webbed. Pelage similar in general to that of *Condylura*, but shorter, finer, and with

*External characters.*—Smallest of the American *Talpidae*; body somewhat robust, not much depressed. Tail moderate in length (about half as long as head and body), moderately fleshy, constricted at base, scaled, very distinctly annulated, sparsely covered with coarse hairs (fig. 24). Head conoidal, relatively long, not much depressed. Snout elongate, terminating in a naked disk or pad, apical superior surface naked to line of anterior edge of nasals; nostrils lateral in terminal pad, slightly crescentic, with anterior end of crescent enlarged and its concavity upward (fig. 25). Eyes minute (relatively about as in *Condylura*), concealed in the fur. Auricular opening large. Legs short, weak (relatively as in *Condylura*). Fore feet hardly handlike, the palms

underfur less clearly defined. Mammæ, 8: latero-pectoral, 2-2; latero-abdominal, 1-1; inguinal, 1-1.

*Skeletal characters.*—Clavicle relatively long and narrow (for the Talpidæ), length about twice the breadth; concave superiorly, inferior surface with a flat process projecting postero-laterally; not penetrated by a foramen. Humerus about three-fifths as broad as long, weaker medially (as in *Condylura*). Pelvis narrow, bones of opposite sides separated by considerable space (about 2 mm.) under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra without process. Os falciforme rudimentary and scarcely perceptible.

Skull conoidal, moderately depressed, without prominent processes and ridges, with moderately broad braincase, scarcely constricted interorbitally. Mastoids weak. Interparietal large, broad, irregularly semicircular, anteriorly deeply emarginate medially, posteriorly slightly emarginate and usually without a posterior median projection. Frontal region scarcely sloping ventro-anteriorly; frontal sinuses very slightly swollen. Rostrum moderately elongate; anterior ends of premaxillæ not much thickened, extending beyond nasals, forming a somewhat truncate notch anterior to the nasals. Anterior nares opening forward. Zygomata short, narrow, slightly out-curved, directed slightly downward anteriorly, the posterior end forward on squamosal (less so than in *Condylura*). Foramen magnum elliptical, relatively large. Infraorbital foramen large, the plate forming its outer wall relatively broad and heavy. Audital bullæ incomplete; no auditory meatus. External pterygoid region scarcely inflated (relatively more than in

*Condylura*). Mesopterygoid space moderately long and broad, the sides usually gently concave. Palate moderately elongate, relatively narrow, terminating opposite posterior border of last molar; posterior border of palate slightly emarginate, without spine or notch. Anterior palatine foramina moderate, oval; first pair of posterior palatine



FIG. 25.—Snout of *Neürotrichus gibbsii gibbsii* (X1½). No. 83468, U. S. Nat. Mus.; from British Columbia.

B2031-103

foramina moderate, oval to elliptical-oval; second pair minute. Horizontal ramus of mandible slender, nearly straight; coronoid relatively long, erect proximally, curving posteriorly distally into an acute process; angle of mandible relatively short and narrow (smaller than coronoid); inferior mandibular notch relatively shallow and broad.



B2030-103

FIG. 24.—Tail of *Neürotrichus gibbsii hyacinthinus* (X1½). No. 160898, U. S. Nat. Mus., Biological Survey collection; from Aptos, Cal.

*Dental characters.*—First upper incisors very short, relatively broad; second and third small (about half as large as first incisor), somewhat laterally compressed. Upper canine larger than third incisor, triangular, compressed, two-rooted, with a small postero-basal accessory cusp. First upper premolar similar to canine, slightly smaller; second upper premolar large, triangular, with a postero-basal cusp, a postero-internal basal cusplike heel, and sometimes with an anterior cusplike process on the cingulum, which tends to disappear with age. Upper molars W-shaped in transverse section, with an interior basal shelf having a distinctly bicuspidate edge; first and second molars subequal, the third much smaller.



B2032-103

FIG. 26.—Fore foot of *N. g. gibbsii* ( $\times 1\frac{1}{2}$ ). Individual referred to in fig. 24.

First lower incisor small, spatulate, directed slightly antero-interiorly; second and third lower incisors and lower canine similar to first incisor, smaller, successively decreasing in size posteriorly, directed obliquely anteriorly, the canine with a smaller posterior basal tubercle. Lower premolars triangular, each with a posterior cusplike heel and an indistinct posterior median sulcus, the second about twice as large as first and with a small antero-basal tubercle. Lower molars M-shaped in transverse section, slightly compressed laterally (less so than in *Condylura*); interior shelf low and narrow, tricuspidate, the median cusp not bifid; first molar with minute basal tubercle between posterior and median interior cusps; first and second molars subequal, the third smaller. Dentition: i.  $\frac{3}{3}$ ; c.  $\frac{1}{1}$ ; pm.  $\frac{2}{2}$ ; m.  $\frac{3}{3}$ ; total 36.



B2033-103

FIG. 27.—Hind foot of *N. g. gibbsii* ( $\times 1\frac{1}{2}$ ). Individual referred to in fig. 24.

#### Key to Subspecies of *Neurotrichus*.

a.<sup>1</sup> Size smaller; color paler; length of skull less than 23.2 mm.,

*Neurotrichus gibbsii gibbsii* (p. 94).

a.<sup>2</sup> Size larger; color darker; length of skull more than 23.2 mm.,

*Neurotrichus gibbsii hyacinthinus* (p. 97).

#### Descriptions of species and subspecies of *Neurotrichus*.

##### NEÜROTRICHUS GIBBSII GIBBSII (Baird).

##### GIBBS'S MOLE.

(Pl. VI, figs. 1, 1a, 1b, 22.)

*Urotrichus gibbsii* Baird, Report Pacific R. R. Survey, vol. 8, part 1, Mammals, p. 76, 1857.

*Urotrichus Gibbsii* Lord, Naturalist in Vancouver Island and British Columbia, p. 338, 1866.



*Neurotrichus* (sic) *gibbsii* Günther, Proc. Zool. Soc. London, 1880, pl. 42, October, 1880.

*Neurotrichus gibbsii* True, Proc. U. S. Nat. Mus., vol. 7, p. 607, 1885.

*Neurotrichus gibbsii* Bryant, Zoe, vol. 1, p. 359, February, 1891.

*Neurotrichus gibbsi* Merriam, Mazama, vol. 1, p. 228, 1897.

*Neurotrichus gibbsi major* Merriam, N. Am. Fauna No. 16, p. 88, October 28, 1899.

Type locality, Carberry Ranch, altitude 4100 feet, between Mount Shasta and Mount Lassen, Shasta County, California.

*Neurotrichus gibbsii gibbsii* Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.

*Neurotrichus gibbsii major* Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.

*Type locality*.—White River Pass, north of Mount Rainier, Pierce County, Washington.

*Type specimen*.—No.  $\frac{662}{1843}$ , U. S. Nat. Mus.; immature, sex unknown; poorly made skin and fragmentary skull; collected July 15, 1854, by George Gibbs.

*Geographic range*.—Extreme southwestern British Columbia, western Washington and Oregon west of the Cascade Mountains, south in the coast region to Eureka, Humboldt County, Cal., and in the interior, west of the Sierra Nevada, to South Yolla Bolly Mountain, Cal.

*General characters*.—Size small (total length averaging less than 120 mm.); color dark, usually dark mouse gray; tail medium in size (about one-third of total length), scaled in transverse annular rows, covered with a few blackish, coarse hairs; skull small (greatest length usually less than 23 mm.), flat, and not angular.

*Color*.—General tone dark mouse gray to blackish mouse gray, occasionally dusky neutral gray; upperparts and underparts essentially the same color, the underparts rarely slightly paler than the back; the longer hairs in full pelage frequently tipped with whitish, producing a frosted appearance; recently killed animals and specimens little handled generally show purplish and greenish iridescence. The worn pelage is paler and more brownish than the fresh.

*Skull*.—Small (greatest length usually less than 23 mm.), smooth, flat, not much depressed postorbitally, not much constricted interorbitally; frontal sinuses slightly swollen; zygomata short, weak; pterygoids short, weak, laterally flattened; audital bullæ incomplete; rostrum moderate in length and width; dentition moderate; first upper incisors flat and rodentlike; upper canine (third lateral tooth) flattened laterally, much like first upper premolar; anterior portion of cingulum of second upper premolar *not* usually developed into a superior cusplike process.

*Measurements*.—Average of 9 adult males from Sumas, British Columbia: Total length, 113 (107–117); tail vertebræ, 37.1 (34–39); hind foot, 16.6 (15.7–17). Average of 5 adult females from Sumas, British Columbia: 116.6 (111–120); 36.4 (33–40); 17 (17–17). Average of 3 males from Carberry Ranch (type locality of *N. g. major*), Shasta County, Cal.: 119.7 (118–121); 40.3 (39–42); 17 (17–17). *Skull*: Average of 10 skulls of adult males from Sumas, British Columbia: Greatest length, 22.5 (22.1–23); palatilar length, 9.4 (9.1–9.6);

mastoidal breadth, 10.3 (10.1–10.5); interorbital breadth, 5.3 (5.2–5.4); maxillary tooth row, 7.1 (7–7.2); mandibular molar-premolar row, 7.3 (7.1–7.5). Average of 6 skulls of adult females from Sumas, British Columbia: Greatest length, 22.4 (21.5–23); palatilar length, 9.4 (9.2–9.5); mastoidal breadth, 10.2 (9.6–10.5); interorbital breadth, 5.3 (5.1–5.5); maxillary tooth row, 7.1 (6.9–7.2); mandibular molar-premolar row, 7.2 (7–7.3). Average of 2 skulls of males from Carberry Ranch (type locality of *major*), Shasta County, Cal.: Greatest length, 22.7 (22.4–23); palatilar length, 9.3 (9.3–9.3); mastoidal breadth, 10.6 (10.5–10.7); interorbital breadth, 5.4 (5.4–5.4); maxillary tooth row, 7 (6.9–7); mandibular molar-premolar row, 7 (6.9–7.1).

*Remarks.*—This little mole, the most shrewlike of the American members of the family, shows comparatively little geographic variation throughout its rather extensive range; in fact, the local almost obscures the geographic variation. Southward a tendency appears toward an increase in size and toward the development of a cusplike process upon the anterior portion of the cingulum of the second upper premolar; this reaches the climax in *N. g. hyacinthinus*. The presence of this cusplike process on the second upper premolar, however, is not strictly diagnostic since it occasionally crops out, slightly developed, in specimens taken near the northern limit of the range of *N. g. gibbsii*, or may be absent in specimens of *hyacinthinus* taken near the southern border of its range. Thus, it occurs, weakly developed, in a few specimens from Sumas, British Columbia; it is absent in two specimens from Crescent City, Cal., but is present in five young adults from Eureka, Cal., and in one from Goldbeach, Oreg.; some specimens of *hyacinthinus* from Cuddeback and Aptos, Cal., have the process, while others lack it.

The form *Neurotrichus gibbsii major* Merriam<sup>1</sup> is here placed in synonymy under *N. g. gibbsii*. The type of *major* was collected at Carberry Ranch, altitude 4100 feet, between Mount Shasta and Mount Lassen, Shasta County, Cal.; a careful comparison of the type, topotypes, and other specimens from the Shasta region, with a large number of specimens from Washington and British Columbia fails to show any differences between *major* and *gibbsii* worthy of subspecific recognition; specimens of *major* average very slightly larger than *gibbsii* and in some other respects appear to be intermediate in characters between *gibbsii* and *hyacinthinus*, but in size and general proportions of skull they are much nearer *gibbsii*. The presence of an anterior "cusp" on the cingulum of the second upper premolar in *major* is not of diagnostic value, as has been shown in the preceding

<sup>1</sup> Merriam, C. Hart, N. Am. Fauna No. 16, p. 88, 1899.



paragraph, and at best can be considered only an approach toward *hyacinthinus*; nor does the second lower premolar differ essentially from that of *gibbsii*, since it can be matched almost perfectly in any large series of the genus *Neürotrichus* from any locality.

Five specimens examined from Eureka, Cal., are hardly adult, but are provisionally referred to *gibbsii* on account of color and size of skull; when a larger series of specimens, with more adults, is available from this region, a change of decision may be necessary.

*Specimens examined*.—Total number, 146, as follows:

**British Columbia:** Chilliwack Valley, 6; Douglas, 1;<sup>1</sup> Howe Sound, 3; Langley, 1; Sumas, 72; Tammi Hy Creek (Chilliwack Valley), 1;<sup>1</sup> Thurstons, 2.<sup>1</sup>

**California:** Arcata, 1;<sup>2</sup> Beswick, 1; Carberry Ranch, Shasta County, 3; Crescent City, 2; Eureka, 5;<sup>3</sup> Hoopa Valley, 1; Mount Shasta, 4; Salmon Mountains (near Etna Mills), 1; South Yolla Bolly Mountain, 1;<sup>2</sup> Tower House, Shasta County, 2;<sup>2</sup> Trinidad, 3.<sup>2</sup>

**Oregon:** Anna Creek, Mount Mazama, 1; Astoria, 1; Crater Lake, 1; Elk Head, 1; Eugene, 1; Fort Klamath, 4; Goldbeach, 1;<sup>3</sup> McKenzie Bridge, 1; Multnomah Falls, 1; Salem, 1;<sup>4</sup> Seaside, 1; Siskiyou, 1; Vida, 2; Yaquina Bay, 3.

**Washington:** Kirkland, 1; Lake Cushman, 4; Mount Rainier, 2; Mount Vernon, 3; Neah Bay, 1; Seattle, 1; Steilacoom, 2; Tenino, 1; White River, Cascade Mountains (type locality), 1.

## NEÜROTRICHUS GIBBSII HYACINTHINUS Bangs.

### SOUTHERN GIBBS'S MOLE.

(Pl. VI, figs. 2, 2a, 2b, 23.)

*Neürotrichus gibbsii hyacinthinus* Bangs, Amer. Nat., vol. 31, p. 240, March, 1897.

*Neurotrichus gibbsii hyacinthinus* Miller & Rehn, Proc. Boston Soc. Nat. Hist., vol. 30, p. 254, December, 1901.

*Neurotrichus gibbsii hyacinthinus* Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 467, 1905.

*Neürotrichus gibbsii hyacinthinus* Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.

*Type locality*.—Nicasio, Marin County, California.

*Type specimen*.—No. 1240, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ adult, skin and skull; collected March 10, 1894, by C. A. Allen.

*Geographic range*.—Coast region of California from Cuddeback, Humboldt County, south to Fremont Peak, Monterey County.

*General characters*.—Larger than *N. g. gibbsii*; color usually slightly darker; skull larger, relatively wider through braincase and rostrum, with more angular mastoid region.

*Color*.—Much like that of *N. g. gibbsii* but averaging darker; usually blackish mouse gray or dusky neutral gray; often almost black, especially in fresh pelage; in full unworn pelage sometimes

<sup>1</sup> Collection Victoria Mem. Mus.

<sup>2</sup> Collection Mus. Vert. Zool., Univ. California.

<sup>3</sup> Collection Field Mus. Nat. Hist.

<sup>4</sup> Collection Amer. Mus. Nat. Hist.



distinctly overcast with hoary, due to whitish tips of the longer hair; worn pelage paler and more brownish; purplish and greenish iridescence shows in fresh specimens, as in *gibbsii*.

*Skull*.—Similar to that of *N. g. gibbsii* but larger (greatest length usually over 23.5 mm.) and relatively wider through braincase, interorbitally, and through rostrum; mastoid region usually heavier and more angular than in *gibbsii*; anterior portion of cingulum of second upper premolar usually developed into a superior cusplike process.

*Measurements*.—Average of 6 males from Aptos, Santa Cruz County, Cal.: Total length, 121.5 (118–126); tail vertebrae, 38.3 (37–39); hind foot, 16.9 (16.5–17). *Skull*: Young adult male from type locality: Greatest length, 24.2; palatilar length, 9.8; mastoidal breadth, 11; interorbital breadth, 5.7; maxillary tooth row, 7.4; mandibular molar-premolar row, 7.3. Skull of young adult female from type locality: Greatest length, 23.5; palatilar length, 9.6; mastoidal breadth, 10.6; interorbital breadth, 5.4; maxillary tooth row, 7.3; mandibular molar-premolar row, 7.3. Average of 6 skulls of males from Aptos, Santa Cruz County, Cal.: Greatest length, 23.8 (23–24); palatilar length, 9.9 (9.6–10); mastoidal breadth, 10.9 (10.7–11.1); interorbital breadth, 5.6 (5.5–5.7); maxillary tooth row 7.6 (7.4–7.8); mandibular molar-premolar row, 7.6 (7.5–7.7).

*Remarks*.—The southern-coast form of Gibbs's mole, *N. g. hyacinthinus*, differs from the typical northern form, *N. g. gibbsii*, chiefly in its larger size and darker color, though frequently specimens are no darker than typical *gibbsii*. Specimens from the south of San Francisco Bay are not quite so intensely colored as those from the type region, and, on the average, seem to have slightly shorter rostra, but the differences are too trivial for subspecific designation.

*Specimens examined*.—Total number, 58, as follows:

California: Aptos, 10; Burlingame, 1; Cazadero, 1;<sup>1</sup> Cuddeback, 7;<sup>1</sup> Fairfax, 1;<sup>1</sup> Freestone, 1;<sup>1</sup> Fremont Peak, 1; Gualala, 9; Guerneville, 3;<sup>1</sup> Inverness, 4;<sup>1</sup> Mendocino, 1;<sup>1</sup> Nicasio (type locality), 6; Palo Alto, 1;<sup>2</sup> Point Arena, 4;<sup>1</sup> San Geronimo, 1;<sup>1</sup> Santa Cruz, 7.

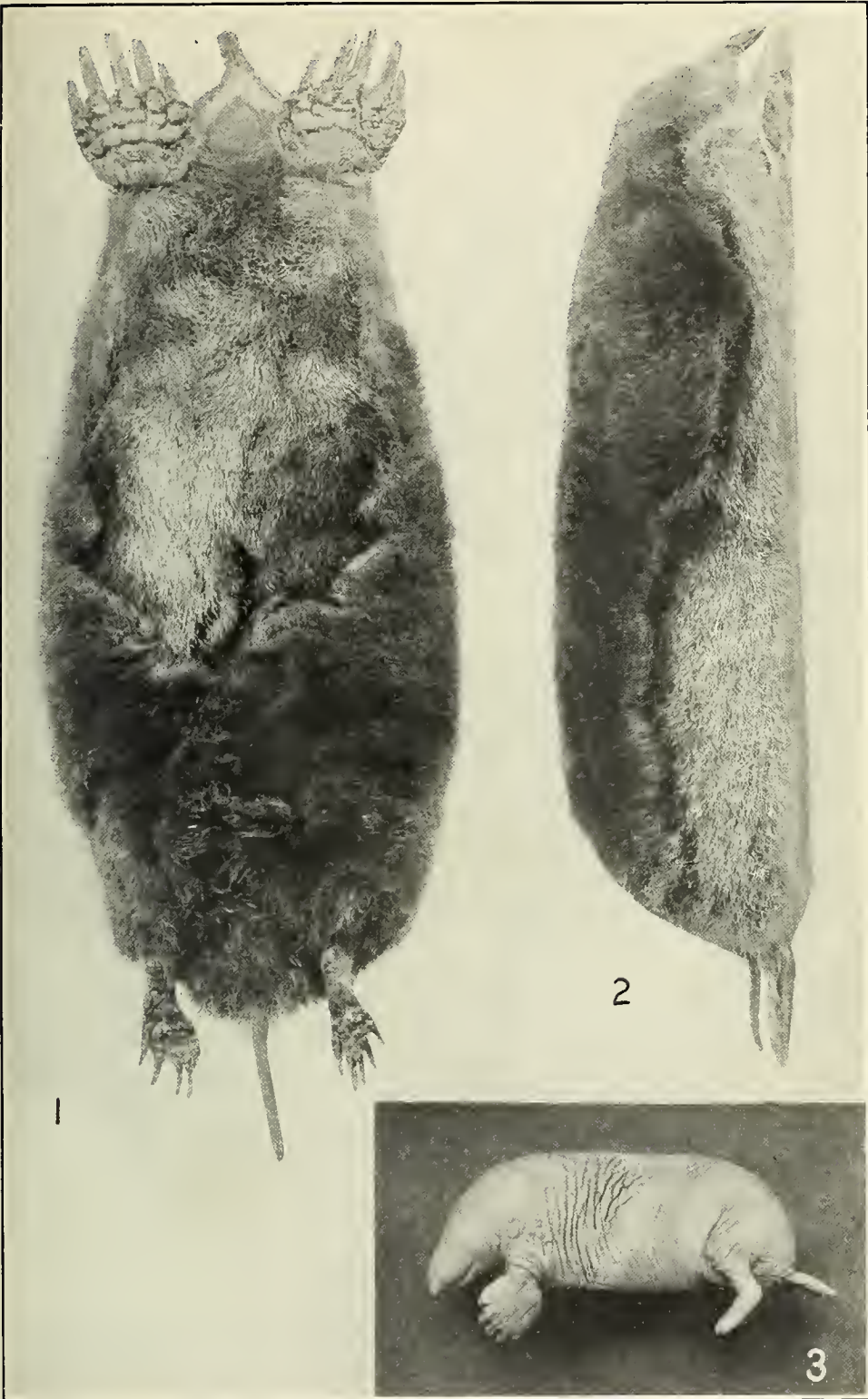
## PLATE I.

[Natural size.]

- FIG. 1. Early stage in molting process of *Scalopus aquaticus aquaticus* (Linnæus); ♀ adult; Fort Myer, Va., April 15, 1897. (No. 83686, U. S. Nat. Mus.)
2. Middle stage in molting process of *Scalopus aquaticus aquaticus* (Linnæus); ♀ adult; Falls Church, Va., May 26, 1907. (No. 144453, U. S. Nat. Mus.)
3. Nestling young of *Scalopus aquaticus howelli* Jackson; Jackson, N. C. (No. 7250, U. S. Nat. Mus.)

<sup>1</sup> Collection Mus. Vert. Zool., Univ. California.

<sup>2</sup> Collection Field Mus. Nat. Hist.



MOLTING AND YOUNG OF SCALOPUS.

- 1, 2. *Scalopus aquaticus aquaticus*.
3. *Scalopus aquaticus howelli*.

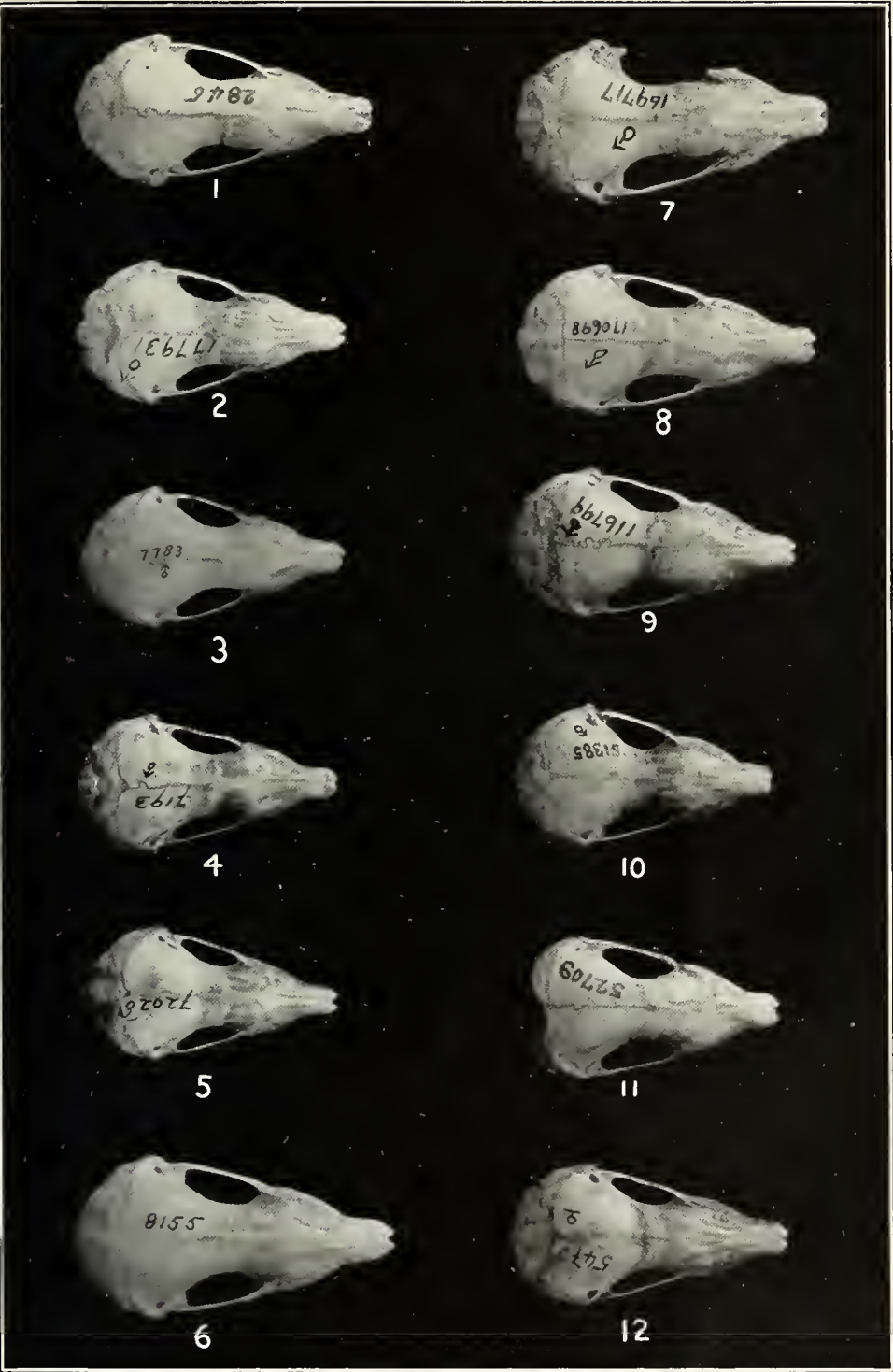
B2001-103

PLATE II.

[Natural size.]

- FIG. 1. *Scalopus aquaticus aquaticus* (Linnaeus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)
2. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)
3. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla. (No. 7783, Field Mus. Nat. Hist.)
4. *Scalopus aquaticus anastasæ* (Bangs); topotype; ♂ adult; Point Romo, Anastasia Island, Fla. (No. 7193, Mus. Comp. Zool., Harvard College, Bangs collection.)
5. *Scalopus aquaticus parvus* (Rhoads); ♂ adult; Port Tampa City, Fla. (No. 7202, Mus. Comp. Zool., Harvard College, Bangs collection.)
6. *Scalopus aquaticus machrinus* (Rafinesque); ♂ adult; Oakwoods Cemetery, Chicago, Ill. (No. 8155, Field Mus. Nat. Hist.)
7. *Scalopus aquaticus machrinoides* Jackson; type; ♂ adult; Manhattan, Kans. (No. 169717, U. S. Nat. Mus., Biological Survey collection.)
8. *Scalopus aquaticus pulcher* Jackson; type; ♂ adult; Delight, Ark. (No. 170698, U. S. Nat. Mus., Biological Survey collection.)
9. *Scalopus aquaticus caryi* Jackson; type; ♂ young adult; Neligh, Nebr. (No. 116799, U. S. Nat. Mus., Biological Survey collection.)
10. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)
11. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)
12. *Scalopus xreus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)





B2002-103

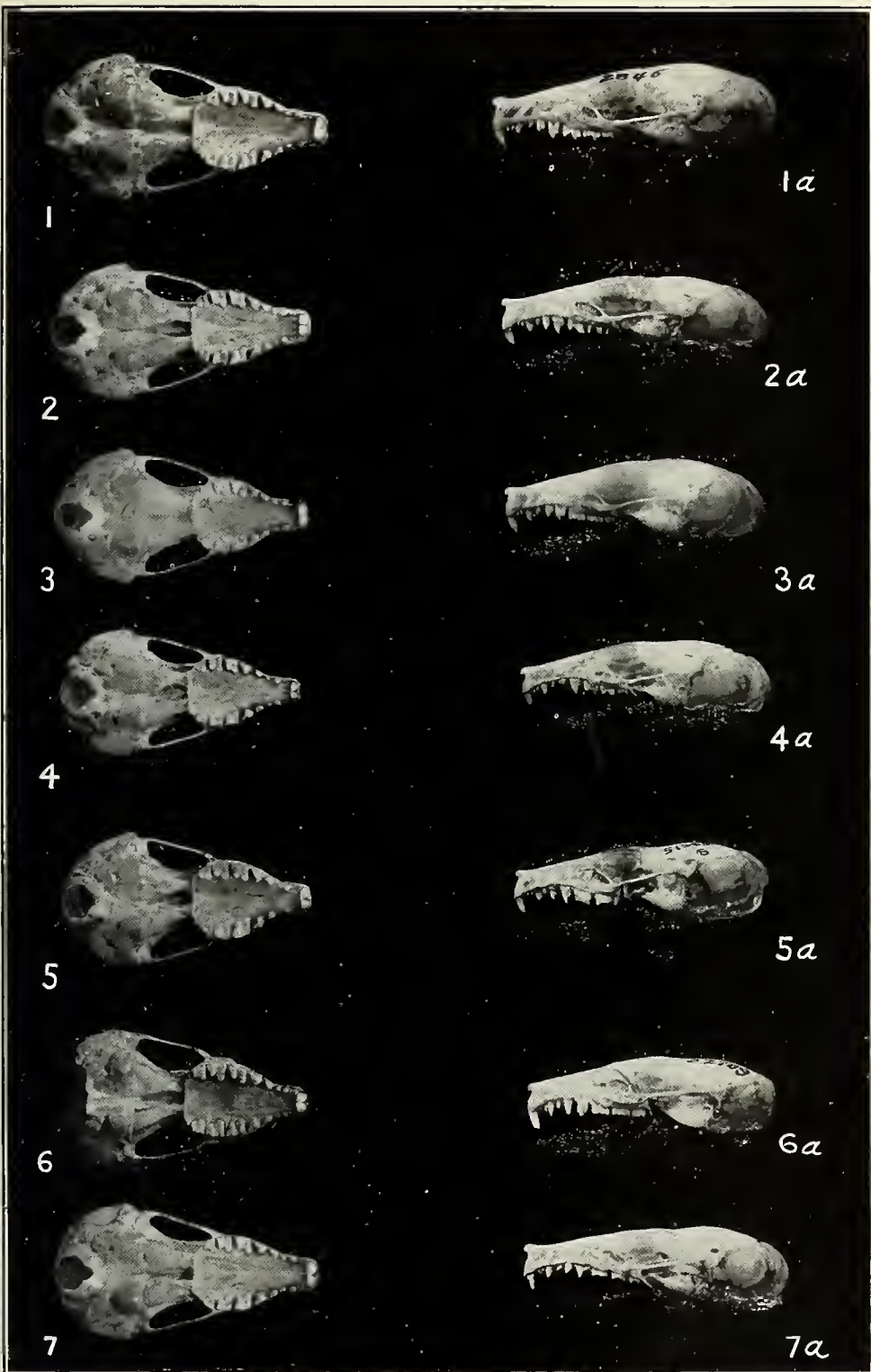
SKULLS OF SCALOPUS AQUATICUS (SUBSP.), S. INFLATUS, AND S. ÆREUS.

- |                            |                               |                           |
|----------------------------|-------------------------------|---------------------------|
| 1. <i>S. a. aquaticus.</i> | 5. <i>S. a. parvus.</i>       | 9. <i>S. a. caryi.</i>    |
| 2. <i>S. a. howelli.</i>   | 6. <i>S. a. machrinus.</i>    | 10. <i>S. a. texanus.</i> |
| 3. <i>S. a. australis.</i> | 7. <i>S. a. machrinoides.</i> | 11. <i>S. inflatus.</i>   |
| 4. <i>S. a. anastasæ.</i>  | 8. <i>S. a. pulcher.</i>      | 12. <i>S. æreus.</i>      |

PLATE III.

[Natural size.]

- FIGS. 1, 1a. *Scalopus aquaticus aquaticus* (Linnæus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)
- 2, 2a. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)
- 3, 3a. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla. (No. 7783, Field Mus. Nat. Hist.)
- 4, 4a. *Scalopus aquaticus parvus* (Rhoads); ♂ adult; Port Tampa City, Fla. (No. 7202, Mus. Comp. Zool., Harvard College, Bangs collection.)
- 5, 5a. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)
- 6, 6a. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)
- 7, 7a. *Scalopus arcus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)



B2003-103

SKULLS OF *SCALOPUS AQUATICUS* (SUBSP.), *S. INFLATUS*, AND *S. ÆREUS*.

1, 1a. *S. a. aquaticus*.  
2, 2a. *S. a. howelli*.

3, 3a. *S. a. australis*.  
4, 4a. *S. a. parvus*.  
5, 5a. *S. a. texanus*.

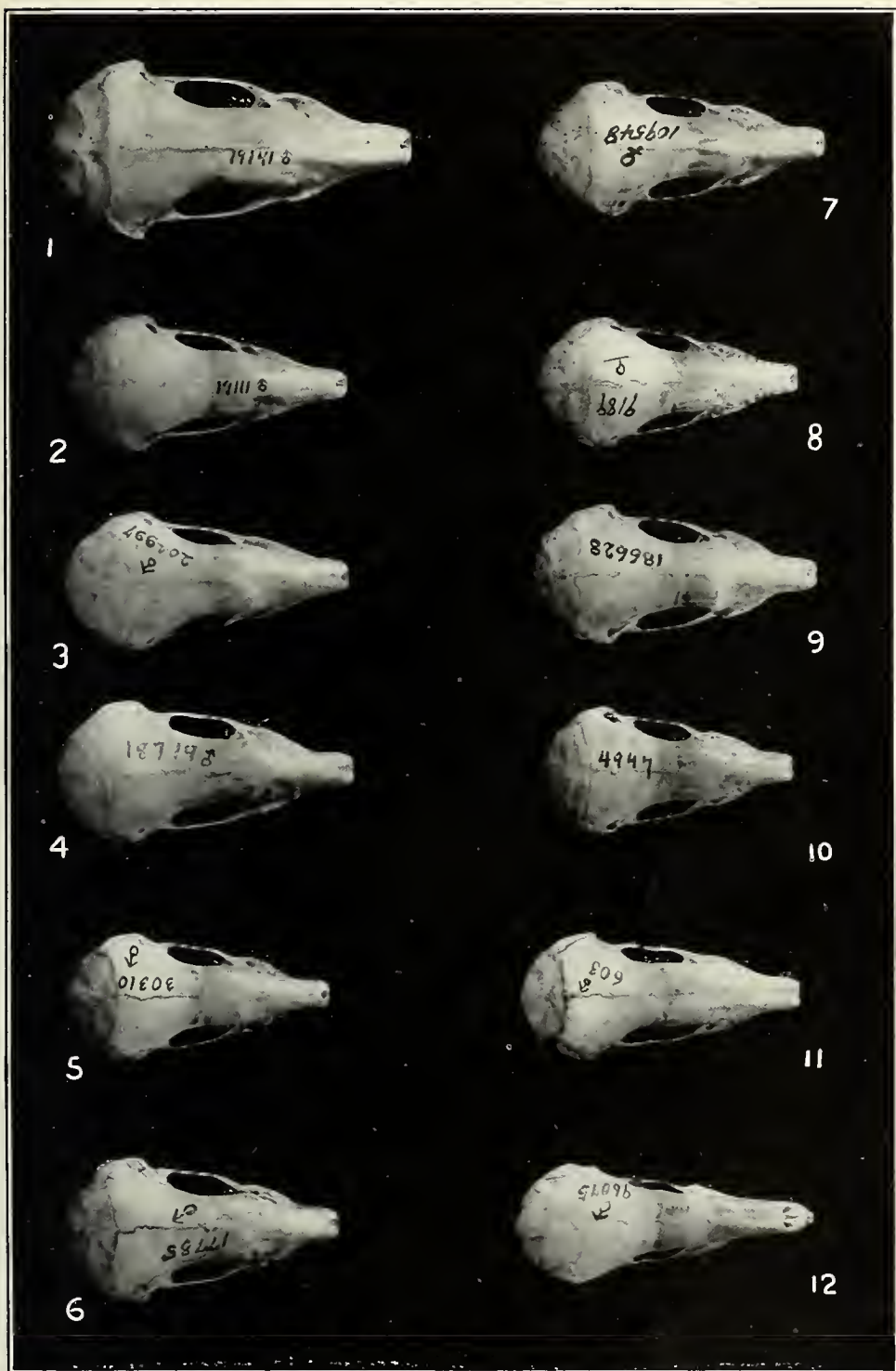
6, 6a. *S. inflatus*.  
7, 7a. *S. æreus*.



PLATE IV.

[Natural size.]

- FIG. 1. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County, Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)
2. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)
3. *Scapanus orarius schefferi* nobis; type; ♂ adult; Walla Walla, Wash. (No. 204997, U. S. Nat. Mus., Biological Survey collection.)
4. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)
5. *Scapanus latimanus occultus* Grinnell & Swarth; ♂ adult; San Gabriel, Cal. (No. 30310, U. S. Nat. Mus., Biological Survey collection.)
6. *Scapanus latimanus grinnelli* Jackson; type; ♂ young adult; Independence, Cal. (No. 17785, Mus. Vert. Zool., Univ. California.)
7. *Scapanus latimanus sericatus* Jackson; type; ♀ adult; Yosemite, Cal. (No. 109548, U. S. Nat. Mus., Biological Survey collection.)
8. *Scapanus latimanus minusculus* Bangs; type; ♀ young adult; Fyffe, Cal. (No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection.)
9. *Scapanus latimanus dilatus* True; type; young adult, sex unknown, probably ♂; Fort Klamath, Oreg. (No. 186628, U. S. Nat. Mus., Merriam collection.)
10. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)
11. *Parascalops breweri* (Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)
12. *Condylura cristata* (Linnaeus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)



B2004-103

SKULLS OF SCAPANUS, PARASCALOPS, AND CONDYLURA.

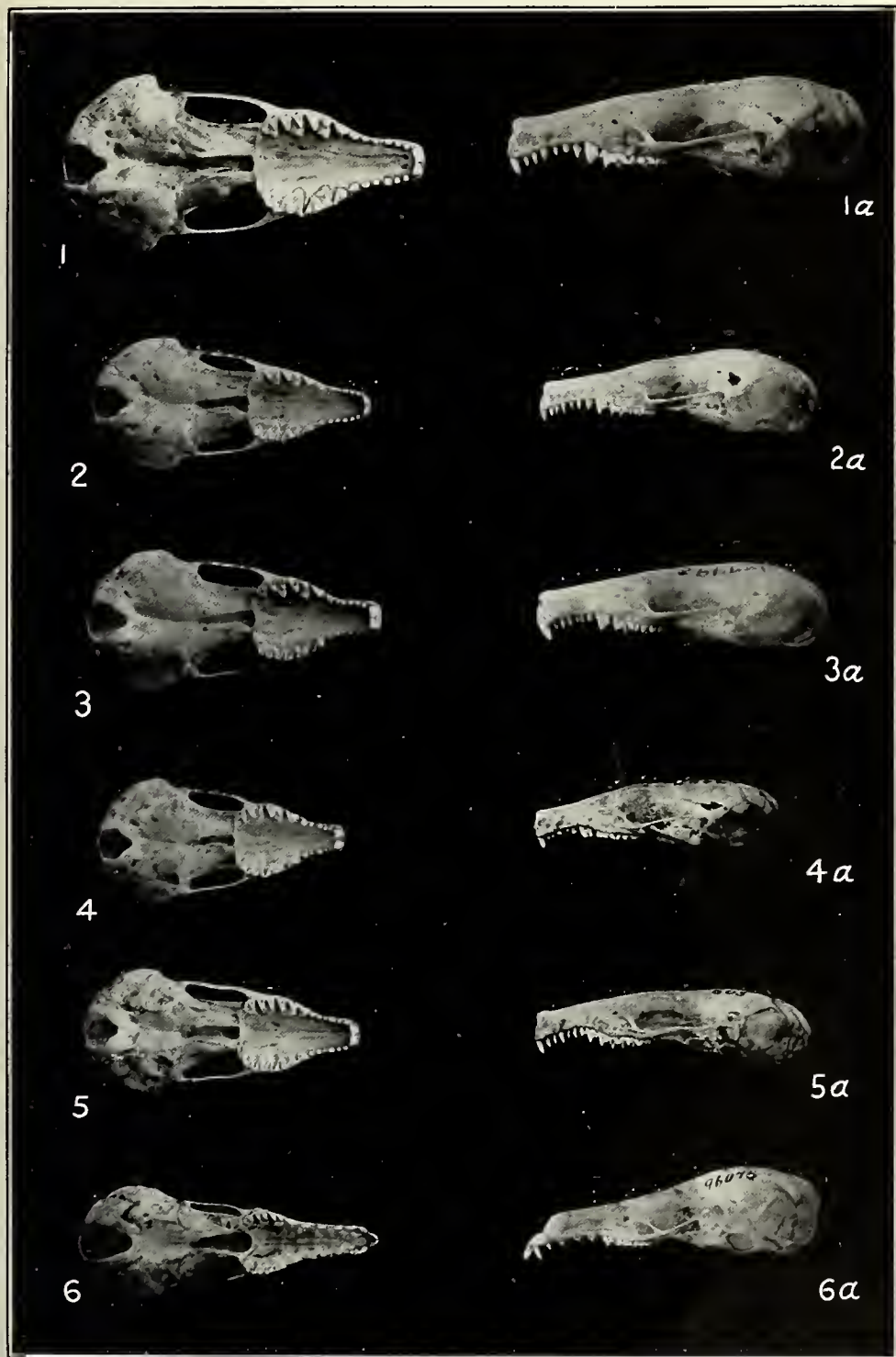
- |                             |                              |                           |
|-----------------------------|------------------------------|---------------------------|
| 1. <i>S. townsendii</i> .   | 5. <i>S. l. occultus</i> .   | 9. <i>S. l. dilatus</i> . |
| 2. <i>S. o. orarius</i> .   | 6. <i>S. l. grinnelli</i> .  | 10. <i>S. anthonyi</i> .  |
| 3. <i>S. o. schefferi</i> . | 7. <i>S. l. sericatus</i> .  | 11. <i>P. breweri</i> .   |
| 4. <i>S. l. latimanus</i> . | 8. <i>S. l. minusculus</i> . | 12. <i>C. cristata</i> .  |

PLATE V.

[Natural size.]

- FIGS. 1, 1a. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)
- 2, 2a. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)
- 3, 3a. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)
- 4, 4a. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)
- 5, 5a. *Parascalops breweri* (Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)
- 6, 6a. *Condylura cristata* (Linnæus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)





B2005-103

SKULLS OF SCAPANUS, PARASCALOPS, AND CONDYLURA.

1, 1a. *S. townsendii*.  
2, 2a. *S. o. orarius*.

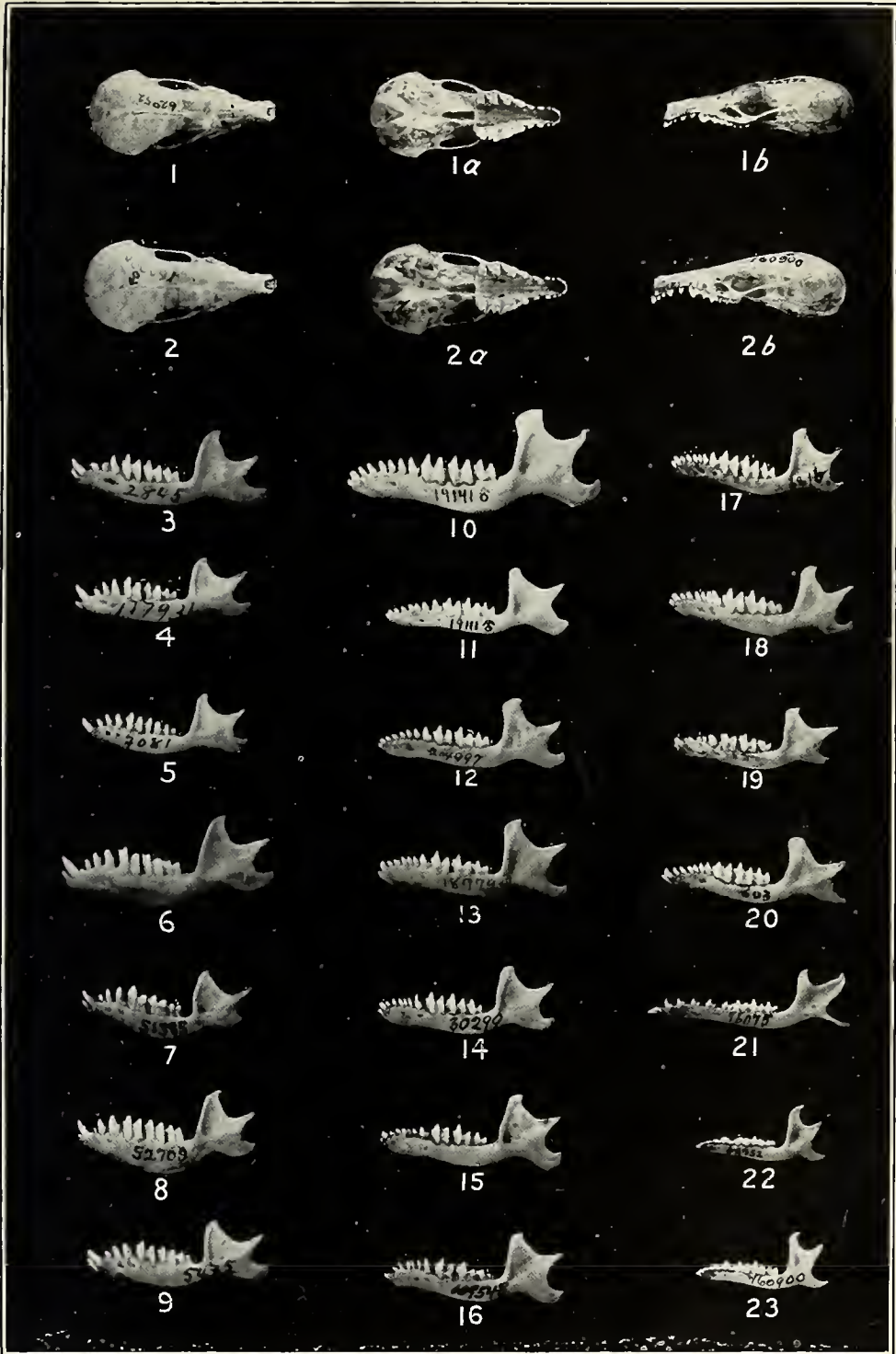
3, 3a. *S. l. latimanus*.  
4, 4a. *S. anthonyi*.

5, 5a. *P. breweri*.  
6, 6a. *C. cristata*.

# PLATE VI.

[Natural size.]

- FIGS. 1, 1a, 1b, 22. *Neurotrichus gibbsii gibbsii* (Baird); ♂ adult; Sumas, British Columbia. (No. 62952, U. S. Nat. Mus.)
- 2, 2a, 2b, 23. *Neurotrichus gibbsii hyacinthinus* Bangs; ♂ young adult; Aptos, Cal. (No. 160900, U. S. Nat. Mus., Biological Survey collection.)
- FIG. 3. *Scalopus aquaticus aquaticus* (Linnaeus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)
4. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)
5. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla., (No. 7081, Mus. Comp. Zool., Harvard College, Bangs collection.)
6. *Scalopus aquaticus machrinus* (Rafinesque); ♂ adult; Oakwoods Cemetery, Chicago, Ill. (No. 8155, Field Mus. Nat. Hist.)
7. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)
8. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)
9. *Scalopus arcus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)
10. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County, Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)
11. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)
12. *Scapanus orarius schefferi* nobis; type; ♂ adult; Walla Walla, Wash. (No. 204997, U. S. Nat. Mus., Biological Survey collection.)
13. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)
14. *Scapanus latimanus occultus* Grinnell & Swarth; ♂ adult; Alhambra, Cal. (No. 30299, U. S. Nat. Mus., Biological Survey collection.)
15. *Scapanus latimanus grinnelli* Jackson; type; ♂ young adult; Independence, Cal. (No. 17785, Mus. Vert. Zool., Univ. California.)
16. *Scapanus latimanus sericatus* Jackson; type; ♀ adult; Yosemite, Cal. (No. 109548, U. S. Nat. Mus., Biological Survey collection.)
17. *Scapanus latimanus minusculus* Bangs; type; ♀ young adult; Fyffe, Cal. (No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection.)
18. *Scapanus latimanus dilatus* True; type; young adult, sex unknown, probably ♂; Fort Klamath, Oreg. (No. 186628, U. S. Nat. Mus., Merriam collection.)
19. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)
20. *Parascalops breweri* (Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)
21. *Condylura cristata* (Linnaeus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)



B2006-103

SKULLS OF NEÜROTRICHUS, AND MANDIBLES OF AMERICAN TALPIDÆ.

- |                                            |                                    |                                     |
|--------------------------------------------|------------------------------------|-------------------------------------|
| 1, 1a, 1b, 22. <i>N. g. gibbsii</i> .      | 8. <i>Scalopus inflatus</i> .      | 15. <i>Scapanus l. grinnelli</i> .  |
| 2, 2a, 2b, 23. <i>N. g. hyacinthinus</i> . | 9. <i>Scalopus æreus</i> .         | 16. <i>Scapanus l. sericatus</i> .  |
| 3. <i>Scalopus a. aquaticus</i> .          | 10. <i>Scapanus townsendii</i> .   | 17. <i>Scapanus l. minusculus</i> . |
| 4. <i>Scalopus a. howelli</i> .            | 11. <i>Scapanus o. orarius</i> .   | 18. <i>Scapanus l. dilatus</i> .    |
| 5. <i>Scalopus a. australis</i> .          | 12. <i>Scapanus o. schefferi</i> . | 19. <i>Scapanus anthonyi</i> .      |
| 6. <i>Scalopus a. machrinus</i> .          | 13. <i>Scapanus l. latimanus</i> . | 20. <i>Parascalops breweri</i> .    |
| 7. <i>Scalopus a. texanus</i> .            | 14. <i>Scapanus l. cecultus</i> .  | 21. <i>Condylura cristata</i> .     |





# INDEX.

[New names in **bold-face type**; synonyms in *italics*.

- acquaticus*, *Scalopus*, 33.  
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*æncus*, *Scalops*, 58.  
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*anthonyi*, *Scapanus*, 75-76.  
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*Sorex*, 32.  
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*praspinatus*, 87.  
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*Astromydes*, 83.  
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*Scalopus*, 38-39.  
*breweri*, *Parascalops*, 79-82.  
*Scalops*, 79.  
*Scapanus*, 80.  
*Scaphanus*, 80.  
*Talpa*, 80.  
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*Scapanus*, 64.  
*canadensis*, *Scalops*, 33, 58.  
*Talpa*, 87.  
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*caudata*, *Talpa*, 87.  
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*cristata*, 86-91.  
*fissipes*, 87.  
*longicaudata*, 87.  
*macroura*, 87.  
*prasinata*, 87.  
*Condylus*, 83.  
*cristata*, 87.  
*Condytura*, 82.  
*cristata*, 87.  
*cristata*, *Condylura*, 86-91.  
*Condylus*, 87.  
*Condytura*, 87.  
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*Talpasorex*, 87.  
*cristatus*, *Astromydes*, 87.  
*Rhinaster*, 87.  
*Scalops*, 87.  
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*Sorex*, 86.  
*cupreata*, *Talpa*, 33.  
*dilatatus*, *Scapanus*, 72-75.  
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*Nëurotrichus*, 95.  
*Urotrichus*, 94.  
*gibbsii*, *Urotrichus*, 94.  
*grinnelli*, *Scapanus*, 69-70.  
*howelli*, *Scalopus*, 36-38.  
*hyacinthinus*, *Neurotrichus*, 97.  
*Neürotrichus*, 97-98.  
*inflatus*, *Scalopus*, 53-54.  
*intermedius*, *Scalops*, 49.  
*Scalopus*, 49-50.  
*latimanus*, *Scalops*, 64.  
*Scapanus*, 64-67.  
*longicaudata*, *Condylura*, 87.  
*Talpa*, 86.  
*Talpasorex*, 87.  
*longicaudatus*, *Rhinaster*, 87.  
*machrina*, *Talpa*, 42.  
*machrinoides*, *Scalopus*, 45-46.  
*machrinus*, *Scalops*, 42.  
*Scalopus*, 42-44.  
*macroura*, *Condylura*, 87.  
*Rhinaster*, 87.  
*macrurus*, *Rhinaster*, 87.  
*major*, *Neurotrichus*, 95.  
*Neürotrichus*, 95.  
*metallescens*, *Scalops*, 58.  
*minuseculus*, *Scapanus*, 72.  
*Neourotrichus*, 92.  
*Neurotrichus*, 92.  
*gibbsi*, 95.  
*gibbsii*, 95.  
*hyacinthinus*, 97.  
*major*, 95.  
*Nëurotrichus*, 92.  
*gibbsii*, 95.  
*Neürotrichus*, 92-94.  
*gibbsii*, 94-97.  
*hyacinthinus*, 97-98.  
*major*, 95.  
*occultus*, *Scapanus*, 68-69.  
*orarius*, *Scapanus*, 61-62.  
*Parascalops*, 77-79.  
*breweri*, 79-82.

- parvus*, *Scalops*, 41.  
*Scalopus*, 41-42.  
*pennantii*, *Talpa*, 42.  
*pennsylvanica*, *Scalops*, 33.  
*pensylvanica*, *Talpasorex*, 33.  
*pensylvanicus*, *Talpa*, 33.  
*Perascalops*, 77.  
*prarinatus*, *Astromycter*, 87.  
*prasinata*, *Condylura*, 87.  
*prasinatus*, *Astromycter*, 87.  
*pulcher*, *Scalopus*, 46-48.  
*purpurascens*, *Talpa*, 87.  
  
*radiata*, *Talpa*, 87.  
*radiatus*, *Sorex*, 87.  
*reposta*, *Talpa*, 80.  
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